Aviation Week

Including Space Technology

May 26, 1958

How Sud Builds Jet Caravelle

—

Satellites' Size, Thrust Compared

requires no wrench clearance...

IT'S THE "LITTLEST" SELF-LOCKING NUT... ...IN THE WORLD!

Another "first" by Kaynar—originator of every major improvement in self-locking nuts in the last 20 years!

We eliminated conventional hex nut wrenching surfaces to give you the Kaylock H50, a *two-point* miniature self-locking nut that enables you to reduce your present space dimensions as much as one-third! H50 self-locking nuts are installed by wrenching on the *threaded nut element itself* with standard spin-type or socket wrenches *3 to 4 sizes smaller* than required by standard hex nuts.

And because the wrench never touches the mounting surface, troublesome scratching and damage is eliminated.

Your Kaylock consultant can point out limitless applications in which the H50 offers definite advantages.

Available in thread sizes #4-40, 6-32 and 8-32.

KAYLOCK.

all-metal self-locking nuts

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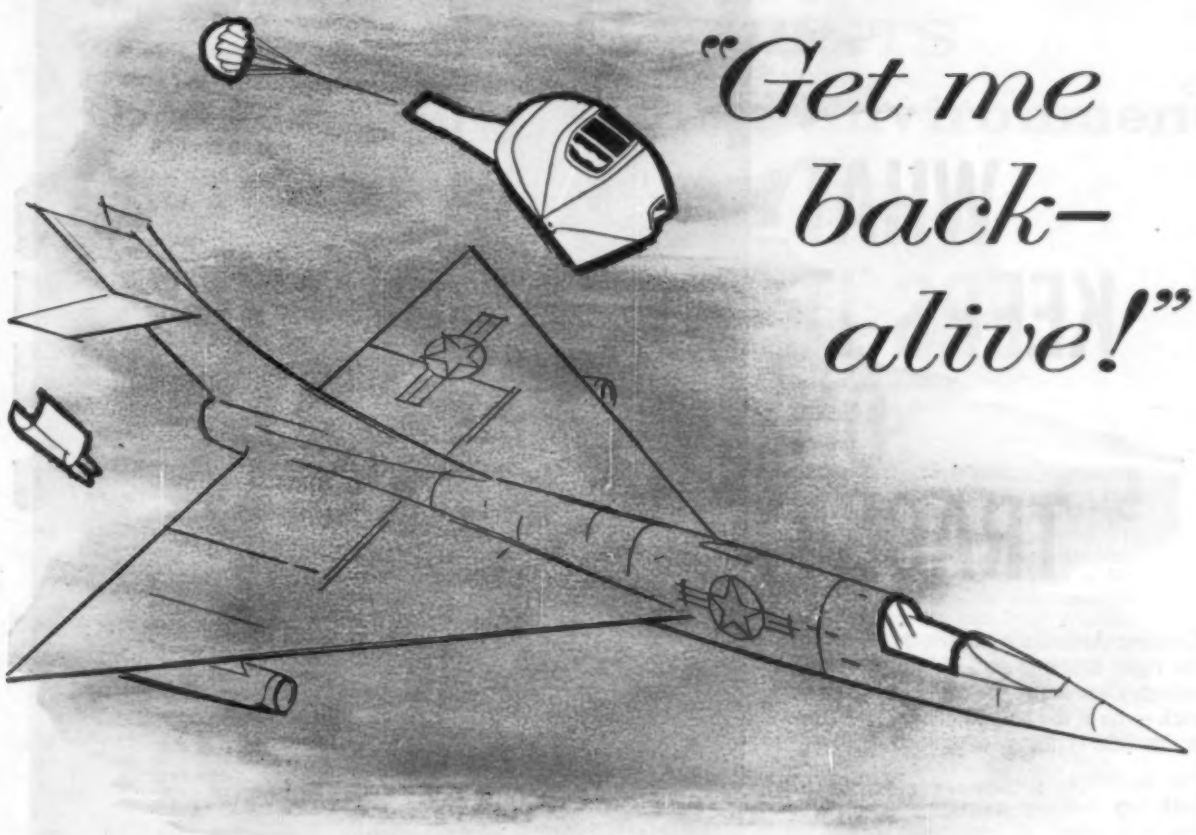
Get the original - by Kaylock

NOW READY: THE SUREST ANSWER TO



"Get me back-alive!"

DESIGNED TO MEET THE EXTREME REQUIREMENTS OF SUPERSONIC AIRCRAFT—THE GOODYEAR CAPSULE PROVIDES RECOVERY CAPABILITY FROM OFF-THE-DECK TO THE MAXIMUM OPERATIONAL ALTITUDE AND MACH NUMBER. HERE ARE THE FACTS:

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Flotation capability after a water landing—and underwater escape potential from ditched aircraft.

Complete global survival equipment protected within the capsule structure—yet readily accessible after descent to earth.

This escape capsule has been designed to meet Air Force and Navy requirements. It is ready now to meet yours, in present and future aircraft designs.

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Keeping America's missile program on the right track is one of the electronic industry's most important jobs. Andrea, with some of the best talent and facilities in the field is doing its part to help.

For instance, Andrea has teamed up with top defense organizations in solving a myriad of electronic problems occuring in critical and highly classified missile development. This is just an example of how the resources and manpower of Andrea can augment your organization in a wide range of electronic work.

Imagination, ingenuity, industry—that's the "bible" at Andrea, a company known to all departments of defense for consistent top level quality performance in engineering and production of advanced electronic design.

Andrea can help you with your electronic problems. Write on your letterhead to:

SYSTEMS DIVISION

Andrea

RADIO CORP.,
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A Pioneer Name in Electronics—Research, Development, Production, Weapons Systems, Navigation, Advanced Intercommunication Systems, Semi Conductor Applications.

AVIATION CALENDAR

June 2-4—National Telemetering Conference, Lord Baltimore Hotel, Baltimore, Md.

June 4—Business Aircraft Conference, sponsored by Chicago Assn. of Commerce and Industry, Hotel Sherman, Chicago, Ill.

June 4-5—West Coast Magnesium Symposium, correlated program by the Society of Aircraft Materials and Process Engineers and the Magnesium Assn., Institute of Aeronautical Sciences Bldg., Los Angeles, Calif.

June 4-6—Second National Conference on Production Techniques, sponsored by the Institute of Radio Engineers Professional Group on Production Techniques, Hotel New Yorker, New York, N. Y.

June 5-6—13th Annual National Meeting, Armed Forces Chemical Assn., Hotel Traymore, Atlantic City, N. J.

June 9-12—American Rocket Society Semi-annual Meeting and Astronautical Exposition, Hotel Statler, Los Angeles, Calif.

June 9-13—Fourth International Automation Exposition and Congress, Coliseum, New York, N. Y.

June 16-18—Second National Convention on Military Electronics, Sheraton Park Hotel, Washington, D. C.

June 19-21—Annual Meeting, Institute of Navigation, University of California Santa Barbara College, Goleta, Calif.

June 22-27—61st Annual Meeting, American Society for Testing Materials, Hotel Statler, Boston, Mass.

June 22-27—Summer General Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Statler Hotel, Buffalo, N. Y.

June 23-24—Summer Meeting, Western States Section, the Combustion Institute, Dwinelle Hall, University of California, Berkeley, Calif.

June 24-26—31st Meeting, Aviation Dis-

(Continued on page 6)

AVIATION WEEK Including Space Technology

May 26, 1958

Vol. 68, No. 21

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Postmaster: Please send form 3579 to Aviation Week, including Space Technology, 330 West 42nd Street, New York 36, N. Y.

TELEMETERING COMPONENTS for Severe Environment

HIGH POWER RF SWITCH, TYPE 1696 will switch a transmitter from one antenna to another at high power levels without mismatching the transmitter for *safe switching under power*. This unit is also applicable for ground use. FREQUENCY RANGE: 215 to 250 Mc/s (other ranges on special order); ATTENUATION: 0.25 db, maximum; POWER RATING: 100 watts R.F. C.W.; VSWR: 1.2 maximum; SWITCHING TIME: .15 sec. average; SIZE: approximately 2½ inch diameter by 4½ inch long; WEIGHT: 2 lbs.; ACTUATING POWER: 6 watts D.C.; CROSS TALK: 27 db down into unused channel; SEQUENCE: Make-before-break.

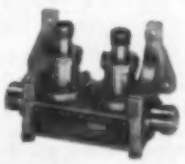
ANTENNAS, tailored to specific missile requirements.

ENVIRONMENTAL SPECIFICATIONS FOR HIGH POWER RF SWITCH, ANTENNAS, DIPLEXER AND VSWR MONITOR

- **SHOCK: up to 100 G**
- **VIBRATION: up to 20 G at frequency of 2000 cps.**
- **TEMPERATURE: Type 1696: −40°F to +250°F.**
  Antennas and Type 1231: Up to 350°F. (Type 1231 made of Invar may be provided at extra cost for use up to 500°F.)
  Type 1273: Calibration shift of less than 3% between 70°F. and 310°F. Satisfactory operation as low as −40°F.
- **ALTITUDE: Unlimited. All units are hermetically sealed.**

DIPLEXER CAVITY, TYPE 1231

Two Diplexer Cavities and circuitry comprise DIPLEXER which feeds signals from 2 - 100 watt transmitters into a single missile antenna system. Frequency Ranges: 215 to 250 Mc/s, other ranges on request; Frequency Spacing: 3 Mc min.; Size and Wt.; each cavity approx. 3" diam. x 4" long. TRIPLEXER with characteristics similar to Type 1231 can be supplied.



VSWR MONITOR, TYPE 1273

This unit monitors RF Power, VSWR and Side-Tone amplitude and furnishes 2 d-c voltages representing incident and reflected power so that antenna power measurements may be made. Power Handling Capacity: up to 500 watts output to Indicator: one volt (nominal) from 500 ohms. Frequency Range: 100 to 400 Mc/s. Factory calibrated at desired frequency.

HYCON EASTERN, INC.

75 Cambridge Parkway Dept. W Cambridge 42, Massachusetts

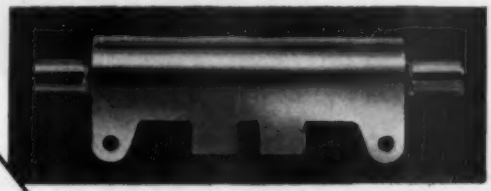
HERE IS THE REMARKABLE

ROTARY ACTUATOR

DESIGNED BY CLEMCO

AERO PRODUCTS, INC.

opening up new horizons in the field of aircraft and guided missiles for the world today... for the universe tomorrow



NOW, CLEMCO ANNOUNCES NEW FEATURES WHICH COMPLETELY REVOLUTIONIZE ROTARY ACTUATOR PERFORMANCE!

New CLEMCO developments in seals have now, for the first time, overcome the leakage, friction, and lost motion barriers.

For the first time CLEMCO has developed stress and deflection analyses which result in rotary actuators of minimum weight, with complete assurance of structural integrity.

NOW, THE THEORETICAL ADVANTAGES OF ROTARY ACTUATORS BECOME A REALITY!

Here's the proof! Internal leakage of less than .05 G.P.M. at 3,000 P.S.I. with static friction of less than 12 inch-pounds is an accomplished fact in actuators having internal seals of a total length exceeding 20 inches. A lower value of internal leakage is practical at the expense of increased static friction.

REMEMBER, CLEMCO HYDRAULIC ACTUATORS ARE CUSTOM DESIGNED

for all modern aircraft and missile applications and can be furnished in an almost unlimited variety of envelope sizes, torque ratings, and dynamic spring constants.

CLEMCO AERO PRODUCTS, INC. are furnishing the leaders of the aircraft and missile industry with the following:

ROTARY ACTUATORS
POWER STEERING UNITS
FLUTTER DAMPERS
MISSILE FINS AND SPARS

PROPRIETARY DESIGNS OF
HYDRAULIC AND PNEUMATIC
UNITS FOR MILITARY AND
COMMERCIAL AIRCRAFT, AND MISSILES

CAP

Write for complete Clemco folder to

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AERO PRODUCTS, INC.

210 E. Manville St., Compton, California

AVIATION CALENDAR

(Continued from page 5)

tributors and Manufacturers Assn., Mount Washington Hotel, Bretton Woods, N. H.

June 27—First Water-Based Helicopter Symposium, sponsored by the Bureau of Aeronautics and Stevens Institute of Technology, Stevens Institute of Technology, Hoboken, N. J.

July 8-11—The Institute of the Aeronautical Sciences, National Summer Meeting, Ambassador Hotel, Los Angeles, Calif.

July 14-15—Triennial Inspection, National Advisory Committee for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, Calif.

July 24-25—Fifth Annual Symposium on Computers and Data Processing, Albany Hotel, Denver, Colo.

July 24-25—Quarterly Regional Meeting, Assn. of Local and Territorial Airlines, Denver, Colo.

Aug. 6-8—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 13-15—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder Laboratories, Boulder, Colo. Jointly sponsored by NBS, American Institute of Electrical Engineers and Institute of Radio Engineers.

Aug. 17-23—Missiles Operations Research, Engineering Seminar, Pennsylvania State University, University Park, Pa.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 25-30—Ninth Annual Congress, International Astronautical Federation, Amsterdam, Holland.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 6-14—International Aviation Show, Coliseum, New York, N. Y.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

Sept. 15-19—Annual Instrument-Automation Conference & Exhibit (International), Instrument Society of America, Philadelphia Convention Hall, Philadelphia, Pa.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla.

Sept. 22-24—Seventh Annual Meeting, Standards Engineers Society, Benjamin Franklin Hotel, Philadelphia, Pa.

Sept. 29-Oct. 3—National Aeronautic Meeting, Society of Automotive Engineers, Inc., the Ambassador, Los Angeles, Calif.

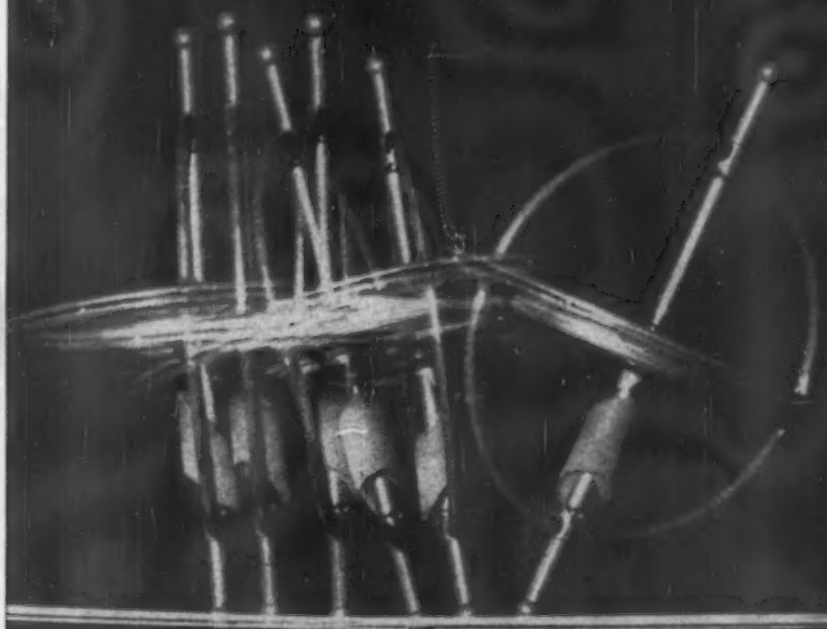
Oct. 27—14th Annual General Meeting of the International Air Transport Assn., New Delhi, India.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Out of advanced research, development and production at Hoffman

GYROS

FOR INERTIAL NAVIGATION AND GUIDANCE SYSTEMS



Electro-Mechanical Equipments — such as the Air Force's AN/ASQ-6 Automatic Dead Reckoning Navigation Computer now in production at Hoffman — include gyroscopes, inertial navigation systems and components, servomechanisms, fire control systems, and guided missile controls. These are examples of the special Hoffman skills and electro-mechanical capabilities which can help solve your design problems.

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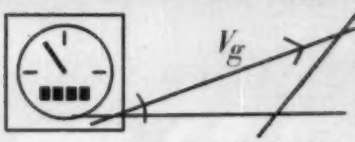
Significant new developments at Hoffman have created important positions for scientists and engineers of high caliber. Please address inquiries to Vice-President, Engineering.



Ground Speed & Drift Angle
Any Time, Anywhere, Any Weather

One look and the pilot KNOWS. In a glance he reads actual ground speed and drift angle.

This vital data, never before available, is displayed on the flight panel automatically and continuously.

The dials "read" the key unit in GPL's revolutionary Doppler auto-navigation systems. Other phenomenal units in these systems tell where you are and how to get where you're going. The systems operate entirely without ground aid or celestial fixes, have proved themselves globally in millions of operational miles.

GPL's auto-navigators are the result of GPL's harnessing of Doppler-effect to air navigation—an achievement comparable in magnitude to the breaking of the sound barrier.

RADAN joins the jet crew

Today's military and jet-liner crews have an added member – an 80-pound navigator named RADAN!*

Guiding the plane with pinpoint precision; telling the pilot his exact velocity second by second; working automatically, continuously, without fatigue – RADAN takes a big load off the rest of the crew. More important, it aids immeasurably in the successful completion of military missions.

RADAN navigators are members of the famed GPL family of Doppler systems developed in conjunction with the USAF (WADC). GPL auto-navigators have literally revolutionized flight. They are the only self-contained systems in the world proved over millions of operational miles.

Recent release of RADAN Systems for civilian use now makes their benefits available to everyone. RADAN saves time and precious fuel for the air lines, provides a priceless margin of safety for all.

GPL

GENERAL PRECISION EQUIPMENT CORPORATION

GENERAL PRECISION LABORATORY INCORPORATED, Pleasantville, N. Y.

*Trademark

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VII

This is the seventh of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Quenching Media for Alloy Steels

In the quenching of alloy steels, several points require consideration, among them being the size and shape of the piece, the type of steel involved, the quenching medium, and proper agitation of the quenching bath.

The composition of the steel has an important bearing on the selection of a quenching medium. As an example: shallow-hardening steels require a fast cooling rate, whereas deeper-hardening steels require progressively slower rates as the alloy content increases.

Three commonly used types of quenching media for alloy steels are water, oil, and air. These are discussed below in the order of quenching severity:

(1) WATER. Fresh water is entirely satisfactory only when used as a flush. Salt-water solutions are generally used in still baths to avoid the bad effect of bubbles resulting from dissolved atmospheric gas. It should be noted that the quenching rate drops as water temperature is increased. The range of 70 deg to 100 deg F is recommended.

(2) OIL. An oil quench cools more slowly than water, and faster than air. Oil-hardening steels can be hardened with less distortion and greater safety than water-hardening steels. Mineral oils are generally used because of their low cost and relatively stable nature.

(3) AIR. If sufficient alloying elements are present, critical cooling rates are decreased to the extent that certain steels can be quenched in either still or forced air.

While the choice of quenching medium is of prime importance, there is another factor that should not be overlooked. This is the agitation of the quenching bath. The more rapidly the bath is agitated, the more rapidly heat is removed from the steel, and the more effective the quench.

Bethlehem metallurgists will gladly help you with any problem related to quenching or other phases of heat-treatment. They are men of long practical experience in this field, and they understand fully the advantages and limitations of each method. Always feel free to call for their services; their time is yours, without obligation.

Remember Bethlehem, too, when you are next in the market for AISI standard alloy steels, special-analysis steels, or carbon grades. We are always in a position to meet your needs promptly.

BETHLEHEM STEEL COMPANY

BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

New Jet Engine Trainer now available to airlines

Link Aviation announces the availability of a unique Jet Engine Trainer that provides ground and flight crews with thorough instruction in jet engine operation.

This Trainer, which has already been ordered by United Air Lines, Trans World Airlines and Continental Air Lines, trains personnel not only in jet engine theory and operation, but in proper maintenance procedures as well.

Link's Jet Engine Trainer will give United, TWA and Continental personnel valuable, realistic experience in starting, operating and shutting down a simulated jet engine under widely varying conditions of altitude, air speed and outside temperature. Maintenance crews will gain valuable insight into repair procedures since the Trainer faithfully simulates failures and near failures—something which could not be duplicated on an actual engine without damaging valuable equipment.

The Link Jet Engine Trainer adds a new dimension to the capabilities of commercial and military aviation by providing the most efficient, most economical means ever devised for thorough jet engine training.

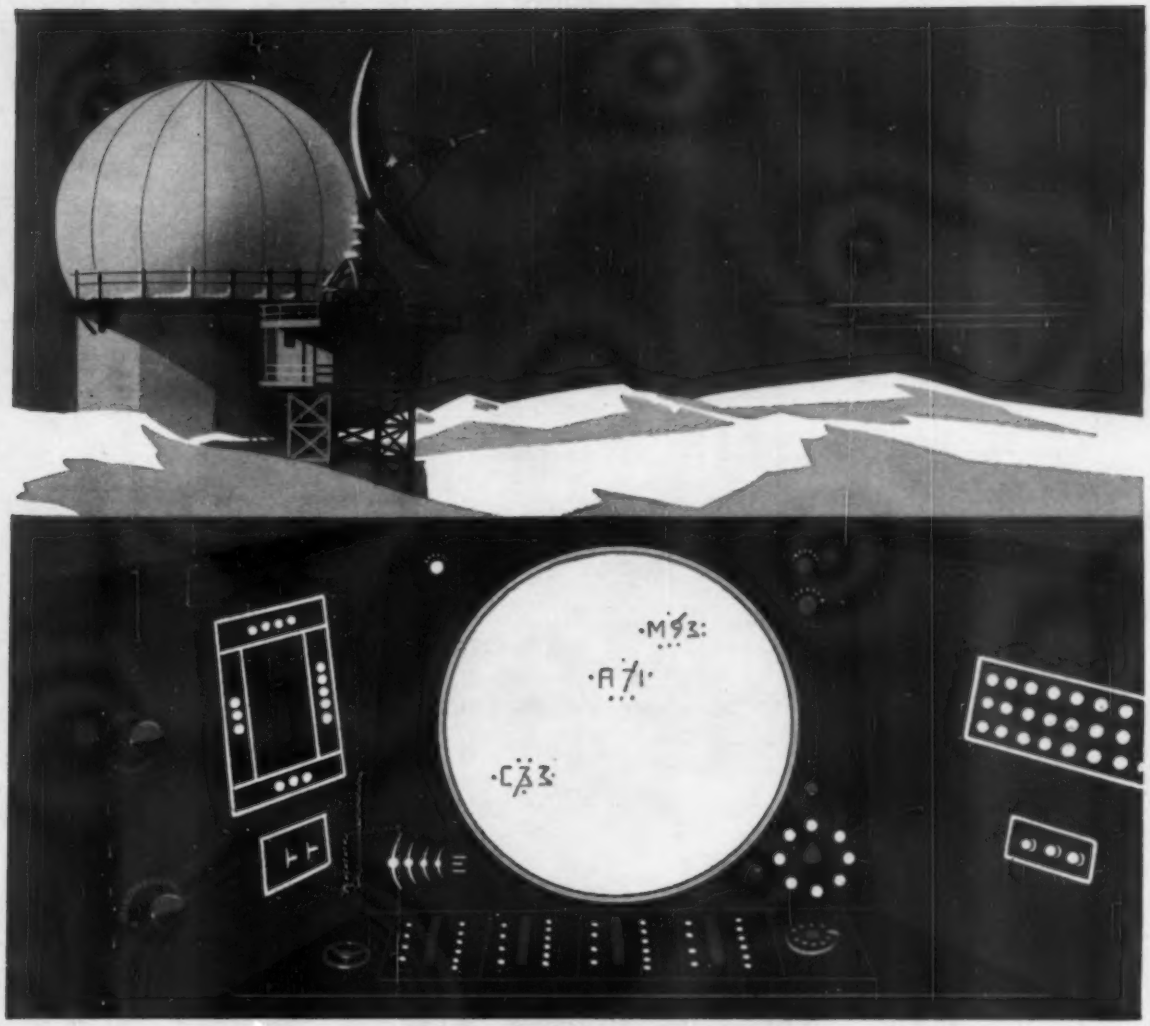
LINK

GENERAL PRECISION EQUIPMENT CORPORATION GPE

Send for free brochure on Link's Jet Engine Trainer

LINK AVIATION, INC.
BINGHAMTON, NEW YORK

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION



From radar antennas to "readout" equipment...

AMF has experience you can use

• Giant search antennas made by AMF form a vital part of the nation's air surveillance network • And converting the incoming radar signals into instantly understandable information are brain-like AMF Electronic Data Display Systems. The ultimate in "readout" equipment, these compact console units accept either analog or digital information, instantly convert, coordinate, and display the data on the face of a cathode-ray tube. Incoming signals can be interleaved with synthetic symbols for immediate reference, and any segment of the display can be offset and enlarged whenever desired. • See for yourself why, for radar control of air, ground, and harbors, or for general-purpose computer reading, AMF has the experience and equipment you can use.

• Armament
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• Radar Antennas
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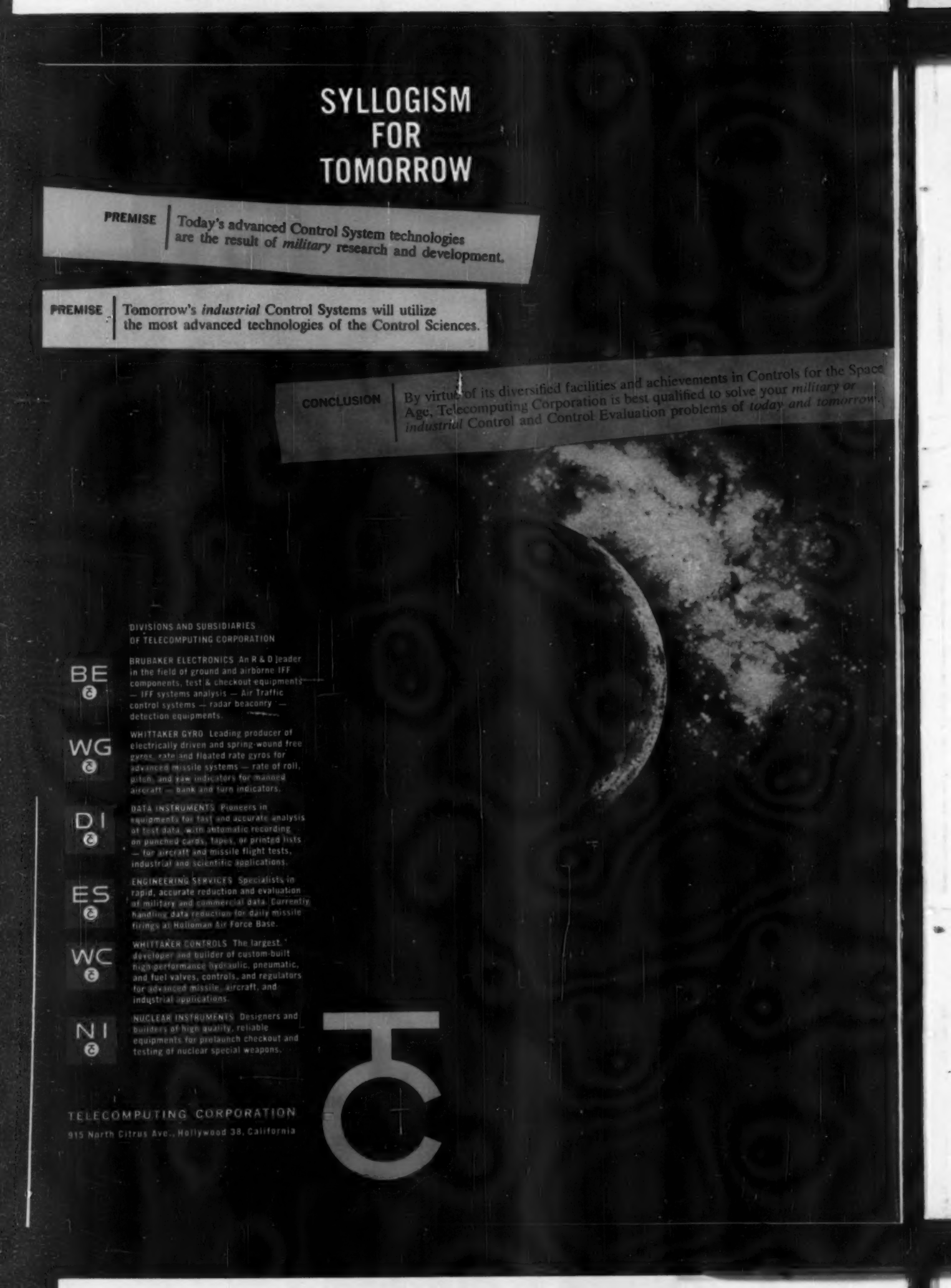
SYLLOGISM FOR TOMORROW

PREMISE | Today's advanced Control System technologies are the result of *military* research and development.

PREMISE | Tomorrow's *industrial* Control Systems will utilize the most advanced technologies of the Control Sciences.

CONCLUSION | By virtue of its diversified facilities and achievements in Controls for the Space Age, Telecomputing Corporation is best qualified to solve your *military or industrial* Control and Control Evaluation problems of *today and tomorrow*.



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WG — WHITTAKER GYRO Leading producer of electrically driven and spring-wound free gyros, rate and floated rate gyros for advanced missile systems — rate of roll, pitch, and yaw indicators for manned aircraft — bank and turn indicators.

DI — DATA INSTRUMENTS Pioneers in equipments for fast and accurate analysis of test data, with automatic recording on punched cards, tapes, or printed lists — for aircraft and missile flight tests, industrial and scientific applications.

ES — ENGINEERING SERVICES Specialists in rapid, accurate reduction and evaluation of military and commercial data. Currently handling data reduction for daily missile firings at Holloman Air Force Base.

WC — WHITTAKER CONTROLS The largest developer and builder of custom-built high-performance hydraulic, pneumatic, and fuel valves, controls, and regulators for advanced missile, aircraft, and industrial applications.

NI — NUCLEAR INSTRUMENTS Designers and builders of high quality, reliable equipments for prelaunch checkout and testing of nuclear special weapons.

TELECOMPUTING CORPORATION

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THE NEW LIGHTWEIGHT A-MP "240" PATCHCORD PROGRAMMING SYSTEM

. . . means lightning fast in-flight reprogramming of airborne electrical/electronic circuitry . . . obsoletes fixed circuit connectors and other systems requiring hours or days to rewire . . . and offers these unusual features:

- removable patchboards to permit complete reprogramming in seconds
- 3¼ pounds to minimize weight . . . miniaturized to conserve space
- rugged shock and vibration-resistant construction with high strength aluminum alloy
- shock-resistant seating of patchcord plugs in removable board
- AMP's patented wiping action that pre-cleans contacts for top electrical performance
- 240 contacts for greatest versatility in circuit combinations or program arrangements

For more information on this new airborne wiring technique, AMP's Patchcord System Catalog is available on request.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through wholly-owned subsidiaries in: Canada • England • France • Holland • Japan

ARMA'S SECRET WEAPON

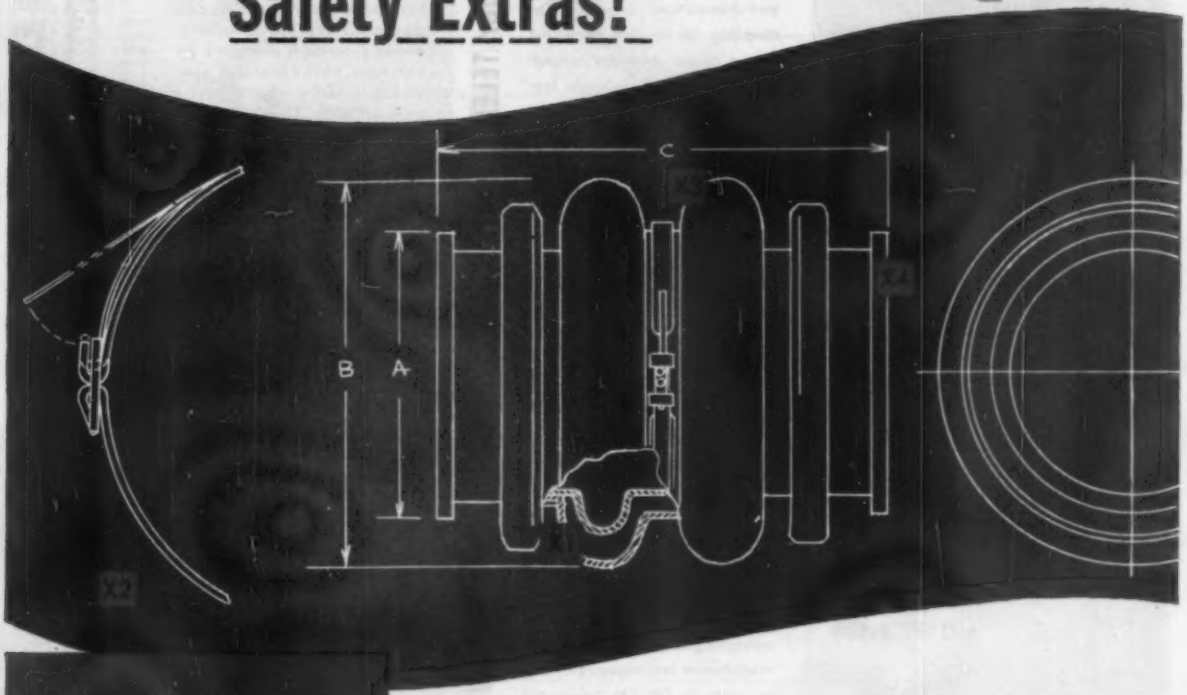
Bug hunting . . . failure testing . . . safety factors . . . flight testing—none of these traditional reliability concepts is sufficient to insure maximum performance of missile guidance systems.

We use them all at Arma—but the designer's pencil is our "secret weapon." For true reliability must originate at the design stage—and then be implemented by a full-scale quality control and reliability program. ARMA . . . Garden City, N. Y. A division of American Bosch Arma Corporation.

4921

AMERICAN BOSCH ARMA CORPORATION

Arrowhead Ducting Design provides Safety Extras!



As an important part of the cabin pressurization and de-icing system, this double duct performs under continuous operation at pressures of 10 to 45 psig and a temperature range from −65°F to +450°F with a high of 700°F.

FOR THE DOUGLAS DC-8 JET AIRLINER

A unique new "duct within a duct" designed and built by Arrowhead performs an extraordinary safety function in the bleed air duct system of the new Douglas DC-8 Jet Airliner. This ducting component provides a "fail-safe" device which signals a warning when excessive leakage developes in the inner duct. The outer duct provides operational safety until the aircraft can be serviced.

Constructed of Arrowhead's Arcosil 27 materials, this double duct has withstood such tests as 185,000 pressure and deflection cycles . . . vibratory accelerations to 15 Gs . . . 180 psig pressure . . . and direct flame (2000F°) for 15 minutes.

This remarkable double duct is only one example of the many customer design problems which are solved by Arrowhead every day. Whether your ducting problem is complex configuration . . . pressure and temperature . . . or resistance to oil and abrasion, the Arrowhead engineering and design group can help you.

For engineering consultation, contact the Field Service Representative in your area or write to the factory direct. Request "Technical Bulletin S-11R."

SAFETY X1. *Double Duct*—A duct within a duct provides an extra emergency safety factor.

SAFETY X2. "FAIL SAFE" DEVICE warns of excessive leakage of inner duct.

SAFETY X3. ARCOSIL 27, silicone rubber-fabric withstands vibration, deflection and direct flame.

FEATURE X4. QUICK-CONNECT COUPLINGS of various types can be specified for fast simple replacement.

Arrowhead PRODUCTS

2330 Curry Street, Long Beach, California

Division of Federal-Mogul-Bower Bearings, Inc.

RADIATION INC.

MELBOURNE AND ORLANDO, FLORIDA

ELECTRONICS · AVIONICS · INSTRUMENTATION

POWER AMPLIFIER

MODEL A-3052-2

This companion unit to the Model 3115 Transmitter is employed to achieve 25 to 100 watts r-f power with as [illegible] the same rugged design criteria are inherent with this instrument as are designed into the Transmitter. It is also approved for use in several missile system programs.

- Frequency—215-260 mc.
- Temperature— −55°C to +75°C
- Shock—100g
- Vibration—20g, 20-2000 cps
- Altitude—0-70,000 ft.

Bulletin RAD B-102

MULTICOUPLER for TELEMETRY RECEIVERS

- 9 Channels
- 55-85 db Interchannel Isolation

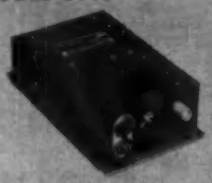
Designed to the exacting specifications of an advanced ground telemetry receiving system used in missile range instrumentation. Provides for coupling up to nine receivers into a single antenna output. High degree of isolation between outputs (55-85 db) effectively eliminates crosstalk [illegible] Tuning range of 216-255 mc and a bandwidth of 30 mc.

Bulletin RAD B-106

MODEL 4-100

FM TELEMETERING TRANSMITTER

MODEL 3115



This new improved model, approved for use in several missile systems, is designed for extreme environmental conditions: 100g shock for 6 milliseconds, 20-2000 cps vibration at 10g, −55° to +75° C, 70,000 ft. altitude. Subminiaturized and crystal-controlled. Spurious output better than 60 db below carrier in the telemetering band.

- Power output—2 watts nominal
- Frequency—215-260 mc
- Weight—32 ounces
- Sensitivity—1.13 vrms
- Deviation—150 kc with 1% linearity
- Output Impedance—50 ohms nominal
- Stability—0.01%

Bulletin RAD B-102

MIXER-MONITOR

MODEL 7-100

This system is capable of accepting as many as four incoming signals from various sources including time and reference, and mixing these signals for recording on a magnetic tape for further processing. Controls provide attenuation and monitoring of individual input signals and the output. Frequency response 300 cps to 100 kc with less than 0.3% harmonic distortion.

Bulletin RAD B-101

RECEIVER PHASE-LOCK DEMODULATOR

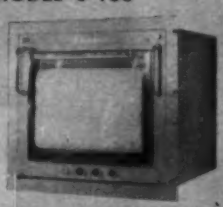
This demodulator applies the advantages of advanced demodulation techniques currently used in FM/FM telemetry receivers. When used with popular receivers, the receiver improvement threshold is lowered by a minimum of 6 db. In this manner, greater range capability is provided for existing systems with no increase in transmitter power. Installation and operation are simplified to the extreme. No soldering is required for connecting to the receiver.

Bulletin RAD B-110

MODEL 8-100

FIXED STYLI RECORDER

MODEL 3-100

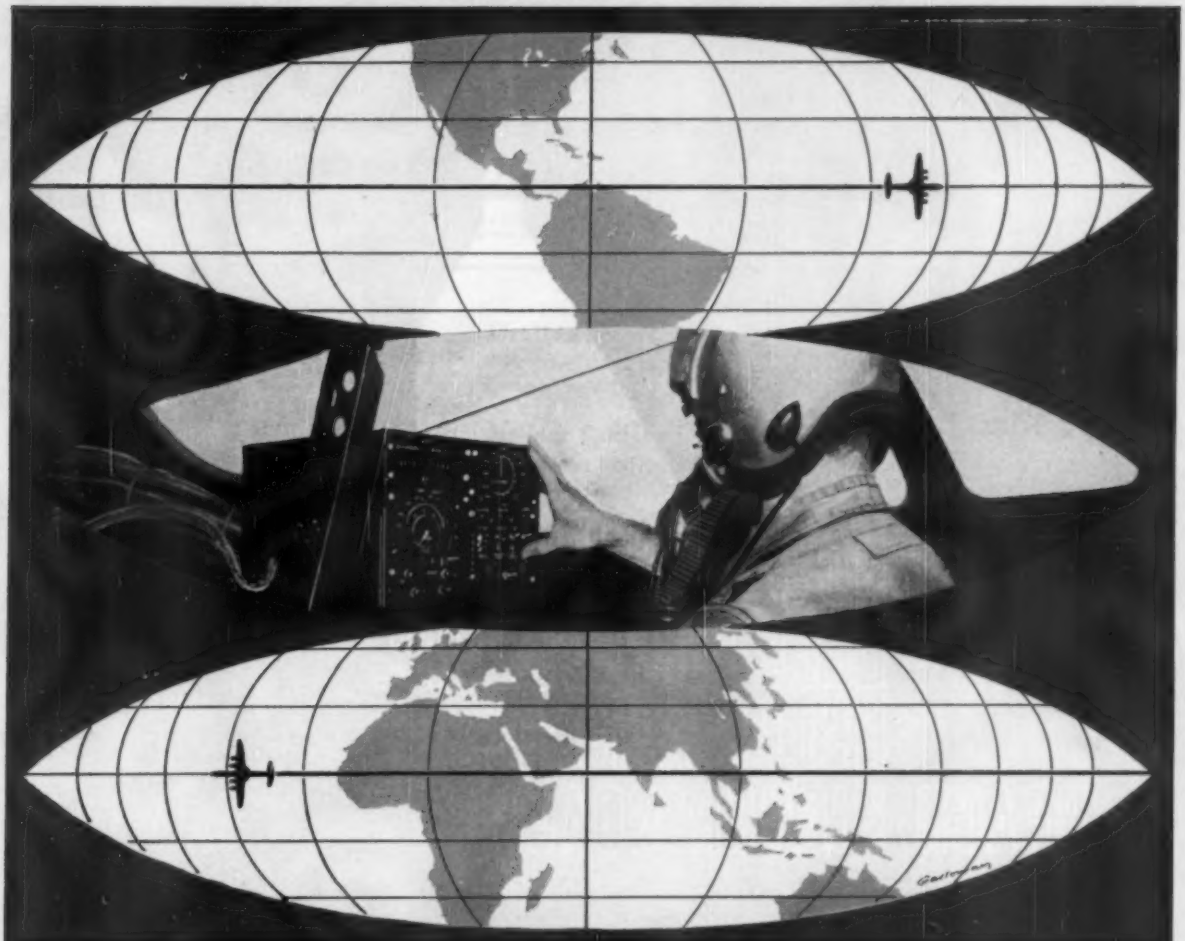


Utilizing 640 individual styli writing on electrosensitive paper this recorder is unique in its variety of applications. *As an on-off recorder-indicator,* it monitors as many as 640 individual circuits at one time. *As a data recorder,* (in the ADAR System) it plots digital data in analog form for immediate analysis. *As a high-speed printer,* it records digital outputs from electronic computers at the rate of 400 lines per second; each line may contain as many as 102 characters. Features: real-time viewing, 100" per second chart speed, no photographic developing, transient response equal to 50-microsecond squarewave.

Bulletin RAD A-100

For more information and specification bulletins write:

RADIATION, INC. · P. O. BOX 37 · MELBOURNE, FLORIDA



Why Ryan C-W Doppler Navigators Are Lightest, Simplest, Most Compact, Most Reliable

Because of its pioneering work in continuous-wave (c-w) radar in cooperation with the Navy and Army, Ryan is producing Doppler navigational systems that have four distinct advantages for both military and commercial applications.

Proved through extensive flight tests over land and sea, in all kinds of weather, Ryan systems provide ground speed, drift angle, present position, ground track, course- and distance-to-destination, course error and other information for special purposes. They are:

LIGHTEST—Ryan Doppler navigators are lightest because c-w radar requires less power for comparable performance and eliminates the need for many components required by pulse radars. Also, Ryan navigators use a unique lightweight non-gimballing antenna system.

SIMPLEST—Ryan c-w Doppler navigators require no i-f (intermediate frequency) amplifiers or automatic frequency control circuits. Only one microwave generator is used and the systems have less tubes and components.

MOST COMPACT—Inherent simplicity of c-w radar sya-tems plus the ingenuity of Ryan design has enabled Ryan to take most advantage of subminiaturization and transistorization, creating compact systems with advanced modular units and etched circuitry.

MOST RELIABLE—Ryan c-w Doppler navigators are most reliable because they are simple, rugged, transistorized, use a long-life transmitter and feature a foolproof, nonwiggly (fixed) antenna with no moving parts and no adjustments.

RYAN BUILDS BETTER

ELECTRONICS DIVISION

Ryan Aeronautical Company, San Diego, Calif.

HOW AMERICAN ELECTRONICS, INC. HELPS AVIONICS REACH HIGHER GOALS

GROUND SUPPORT EQUIPMENT

A typical electrical ground support unit is the portable, motor-driven generator pictured above—designed with multiple high quality, closely controlled electrical outputs. It has two 400-cycle alternators, and one 1000-cycle—with 5 kva, 2 kva and 1 kva, respectively. Air conditioning, high frequency or frequency regulated. Custom engineering specialties and ready to serve your needs now!

Electrical Machinery & Equipment Division

INDUCTION RESOLVERS

High angular accuracy and low null-to-output voltage ratio....under the most extreme environmental conditions. For custom servo packages, a wealth of engineering know-how is available for the complete design and manufacture of any precision size-to-most or exceed your existing system specifications. Featuring resolvers, servo motors, servo inductosyn, inductosyn position

Electro-Mechanical Division

SUB-FRACTIONAL AC & DC MOTORS

Presenting two new concepts in miniature motor design and performance! All stainless steel AC motor series offers reliability under extreme environmental conditions. Automated manufacture brings prices down to the lowest. New permanent magnet DC motor designs offer twice the output in a smaller package. Brushless, reliable, long life, and maintenance free to boot.

Electro-Mechanical Division

RADIFLO LEAK DETECTION

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Read-Curtis Nuclear Division

WRITE on your company letterhead for complete information on any of these products or divisions.

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May 26, 1958

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COVER: Fuselage structure is completed on Scandinavian Airlines System's second Sud Aviation Caravelle. Interior installations are being made at this assembly line location in Toulouse. First production Caravelle made its first flight last week—1 hr. 48 min. at 25,000 ft. A second flight of 4 hr. duration was made the same day. For Caravelle production story and other photos, see page 60.

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29—Sovfoto; 30, 31, 37—North American; 32 (top)—Canadair; 32—J. Havard; 34—Sikorsky; 39—U.S. Army; 41—Convair; 60 (top)—SAS; 60, 61, 67, 69, 75 (bottom)—Aviation Week; 75—Sud Aviation; 111—Klemm-Flug-Zeuge GmbH; 113—Cessna.

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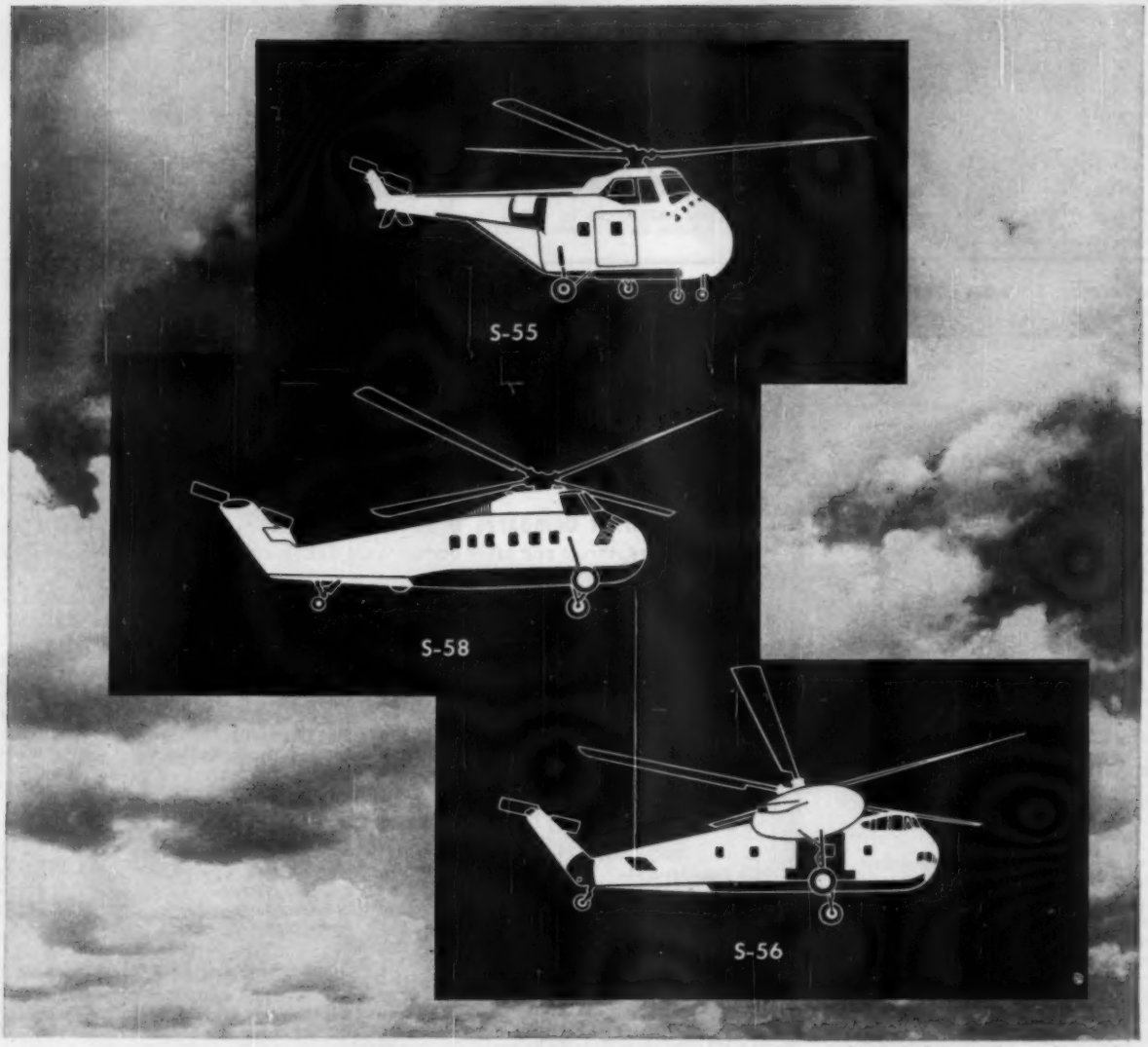


white areas show extensive use of magnesium

MAGNESIUM ALLOYS BUILD BIGGER PAYLOADS INTO SIKORSKY 'COPTERS

Structural dead weight—that ever critical problem in the design of air frames and missiles—is a problem Sikorsky Aircraft solved several years ago.

As every helicopter designer well knows, everything below the rotor is sheer dead weight and contributes nothing to lifting the aircraft. So it's no wonder Sikorsky uses magnesium alloys where they can. This lightest of all structural metals weighs only 65% as much as aluminum. Easy to see how the use of magnesium adds substantially to the payload—by subtracting weight from the structural load.

The S-56, Sikorsky's largest 'copter to date, carries a total of 5,558 lbs. of magnesium. This total includes the wheels, almost the entire skin and numerous other components. Several highly stressed areas, such as the rotor hub plates, are magnesium forgings. Other Sikorsky models, such as the S-58 and S-55, famous Korean War 'copter, also use magnesium alloys to good advantage.

For more information about magnesium, contact your nearest Dow Sales Office or write THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1402K-1.

MAGNESIUM FORM	LBS. USED		
	S-55	*S-58*	*S-56*
Sheet	580	1303	2288
Extrusions	68	51	246
Castings	307	266	1466
Forgings	77	198	1144
Bar and Tube	83	186	414
Total	1,115	2,004	5,558

YOU CAN DEPEND ON DOW

EDITORIAL

Supersonic Transport Era

One of the first things we learned in the aviation writing business was about the pitfalls that yawn for conservative prophets in this field. Since the day Orville Wright first got off the sands of Kitty Hawk, the galloping pace of aviation technology has made a habit of proving even the rosiest prophets to be ultra-conservative in retrospect.

And, so it appears to be now in the jet transport business. For the past few years as a variety of jet transport prototypes took to the air and entered the international sales competition, the prophets also have been busy forecasting. Their forecasts generally predicted at least a decade of subsonic jet transport operations in the 500-600 mph. speed range, with the supersonic transport looming on the technical horizon 10 to 20 years hence.

But galloping technology is already shattering these once reasonable estimates. A few weeks ago (AW May 12, p. 23), we published the fact that Douglas Aircraft Co. was already well along on a Mach 2 transport design for both military and commercial markets. The sages of Santa Monica are holding their supersonic cards pretty close to their vests, and there is not much detail available on this project. But it is obvious that the Douglas supersonic transport is based heavily on DC-8 design experience and component development. Turbojets in the 30,000 lb. thrust class without after burning are already running on test stands.

Douglas Timetable

It seems reasonable to expect Douglas to be ready to fly its Mach 2 prototype in about two years—a tremendous milestone considering the first DC-8 is making its first flight in about November.

Across the hills in Burbank, Lockheed engineers are more communicative about their supersonic transport philosophy. Recently, we spent some pleasant hours with Hall Hibbard, senior vice president of Lockheed Aircraft Corp., on this subject. Lockheed has its sights set on a transport that will cruise at Mach 3—about 2,000 mph.—for its entry in the supersonic jet transport competition. This is truly a breath taking commercial vista—New York to Los Angeles in 90 minutes, across the Atlantic to London in two hours and transpacific in half a day.

Here again, the time scale is amazingly short. If design were begun now—and it is perfectly feasible to do so, Mr. Hibbard assured us—it would be possible to produce a prototype in about two-and-a-half years, take a year for thorough flight testing, have it in production by about 1963-64 for airline operations beginning in 1965.

The Mach 3 transport design is well within the state of the art made possible by our rapid and successful plunge into the supersonic speed range during the past decade. Flight experience with piloted aircraft such as the F-104 Starfighter in the range through Mach 2 and with ramjet test vehicles such as the X-7 in the range past Mach 4 have proved that theoretical projection of Reynolds numbers were far too conservative. Much better results have been achieved in actual flight testing than were anticipated with the slide rule and wind tunnel. Calculations of the increase in drag as speeds increased beyond Mach 1 were far higher than has proved to be the case.

Seat Mile Cost

Mr. Hibbard believes that the Mach 3 transport will cruise in the 50-60,000 ft. altitude layer, carry 85-100 passengers over stages lengths of 1,000 miles and up at a seat mile cost 20% lower than the current crop of subsonic jet transports. The Mach 3 transport could use existing runways because of the tremendous power required for high supersonic cruise and the relatively low wing loading necessary for high altitude performance.

There also will be well developed powerplants available well within the time scale outlined by Mr. Hibbard. There are turbojets in the 60,000 lb. thrust class using standard JP4 jet fuel without any exotic combinations and additives. The same Reynolds number dividends proffered for airframes also applied to the airfoil compressor and turbine blades in the high supersonic range. It may not even be necessary to go to a turbo-ramjet combination. Who would have thought a few short years ago that a straight turbojet could be seriously considered for Mach 3 to Mach 4 performance?

Such well tested giants in the jet engine business as General Electric, Pratt & Whitney Aircraft and Rolls-Royce are all offering turbojets to meet this Mach 3 transport requirement.

Perhaps the most serious problem of the Mach 3 transport will be its passenger environment—assuring full safety in the pressurized capsule that will take man in routine flight far beyond his natural capability for survival. Certainly no passenger would wish to wear the type of space suit planned for Scott Crossfield and his X-15 venture even for a few hours as a safeguard against decompression.

Airline Reaction

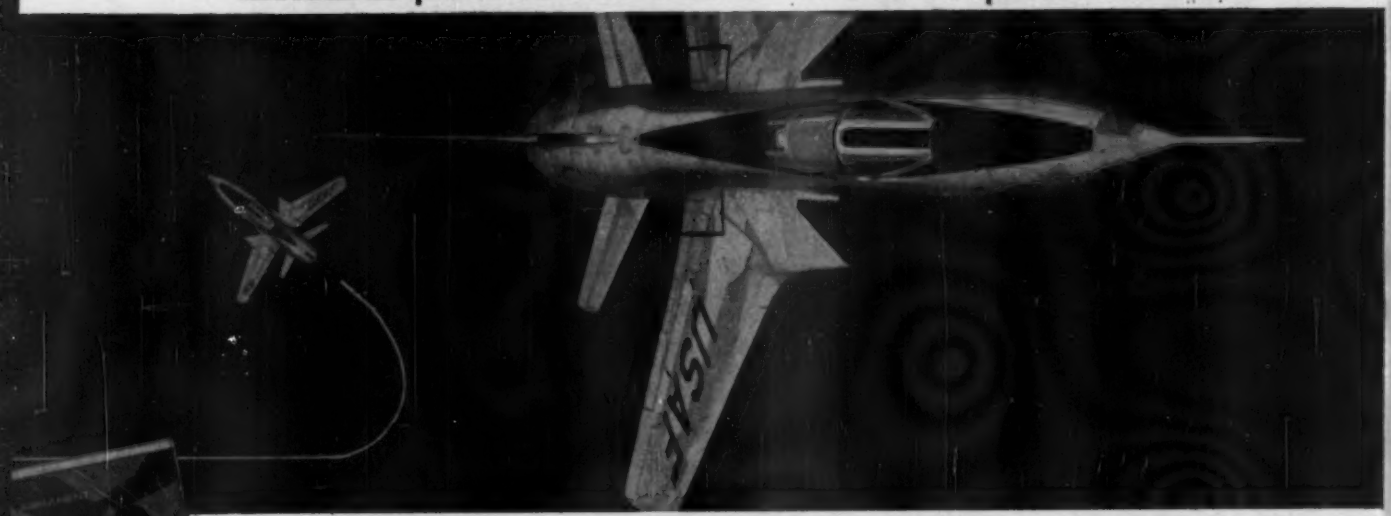
Now this discussion of the Mach 2 and Mach 3 transports may be fine news for the traveling public, particularly the harried business executive whose day never seems long enough. But we can safely predict that not all airline presidents will view this tremendous technical progress as an unmixed blessing.

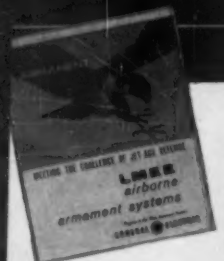
To airline executives now battling the rising cost curve and dropping load factor squeeze simultaneously with the financial and operational problems of beginning subsonic jet transport operations, this may seem to be "too much, too soon."

These problems we will save for discussion another day.

—Robert Hotz

LMEE puts lethal talons in the Republic F-105





LMEE armament control systems help make Republic's F-105 one of the most versatile new weapons available to Tactical Air Command in fulfilling TAC's 3-fold mission: (1) win and hold air superiority, (2) deny an enemy his reinforcements and supply, and (3) give close air support to friendly land and sea forces. ➤➤ In the F-105, LMEE armament control systems are integrated with LMEE flight control systems to provide increased mission capabilities and to simplify the pilot's essential duties. ➤➤ For brochure, **write Dept 4F.**

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A DEPARTMENT IN THE DEFENSE ELECTRONICS DIVISION

WHO'S WHERE

In the Front Office

Dan W. Burns, president, The Hufford Corp., subsidiary of The Siegler Corp., El Segundo, Calif. Mr. Burns succeeds **Merrill L. Bengtson** who continues as chairman of Siegler's executive management committee.

Richard H. Botterill, a director and executive vice president, Vickers-Armstrongs, Inc., Arlington, Va.

Robert B. Muir, vice president of United Aircraft Export Corp., will manage the efforts of United Aircraft Export, United Aircraft Service Corp. and Sikorsky Aircraft in Germany, and also becomes manager for Sikorsky. Also: **Sergei Sikorsky**, staff assistant to Mr. Muir; **L. R. Brahn**, senior service representative, and **Richard Stephansky** and **Elmer Hosking**, test pilots, for the Sikorsky group in Germany.

Herbert E. Markley, vice president, The Timken Roller Bearing Co., Canton, Ohio. **Richard L. Frederick** succeeds Mr. Markley as assistant to the president.

Gerard Q. Decker, a vice president, Servo-Mechanisms, Inc., Hawthorne, Calif.

Alan M. Glover, vice president, Semiconductor and Materials Division, Radio Corporation of America, Somerville, N. J.

William D. Hammond, vice president, Lockheed Aircraft Service-Overseas, Inc., Ontario, Calif.

Robert J. Higley, vice president-planning, Hupp Aviation Co., subsidiary of Hupp Corp., Chicago, Ill.

Gerald Rosenberg, a director and vice president of Consolidated Diesel Electric Corp., Stamford, Conn., elected group vice president for the company's Aircraft, Power, and Test Equipment divisions and West Coast activities.

Gerald M. Henriksen, a director and vice president, Acoustica Associates, Inc., Mineola, N. Y. Also: **Frank P. DeLuca, Jr.**, a vice president, responsible for West Coast facilities, Culver City, Calif.

Andrew R. Mulhall, vice president, Aircraft Supplies, Nutley, N. J. **Allan R. Moulton** succeeds Mr. Mulhall as general sales manager. Also: **William H. Postel**, general manager, and **Herbert B. Koshar**, treasurer.

Col. Albert J. Wetzel has been appointed Military Director of the Air Force Titan ICBM program. Col. Wetzel succeeds **Col. Paul P. Blasingame**, now designated head of the new Department of Astronautics at the Air Force Academy, Denver, Colo.

Honors and Elections

Gen. Curtis E. LeMay, USAF Vice Chief of Staff, has been named recipient of the Godfrey L. Cabot Award, presented annually by the New England Aero Club to the outstanding man of the year in aviation. Gen. LeMay will be cited for his 30-year career in military aviation.

Raymond M. Wilmotte, consulting scientist at The W. L. Maxson Corp., has been awarded a Doctor of Science degree by Cambridge University for his original contribution in the field of electronic engineering.

(*Continued on p. 119*)

INDUSTRY OBSERVER

► Pratt & Whitney JT12 turbojet engine which is now running on the test stand at 2,900 lb. static thrust under simulated Mach 2 conditions was developed from drawing board to successful operation in less than five months. Engine is a single spool design aimed at low specific fuel consumption. It is aimed at applications in the UCX and UTX Air Force aircraft and executive jet transports. Design was completed in January and first engine ran successfully on the test stand early this month. JT12 weighs 430 lb.

► Passive technique for detection of Soviet missile firings by the reception of electromagnetic energy generated by rocket engine gases first disclosed by AVIATION WEEK (AW May 12, p. 26) will be integrated into Air Force's ballistic missile early warning system. With further sophistication, technique will not only reveal point of launch but also direction of flight and velocity at burnout, thereby providing data for determining the approximate point of impact.

► Air Force may soon launch a major program to apply infrared to its early warning airborne systems to make up for deficiencies in present radar detection. Airborne early warning aircraft may be equipped with infrared systems designed for use against both enemy aircraft and ballistic missiles. Operating above altitudes of 20,000 ft. would largely eliminate atmospheric attenuation which handicaps ground-based infrared surveillance systems.

► Unexpected and unexplained high cosmic ray count detected by Explorer I and III satellites (AW May 5, p. 39) will be analyzed directly in a new experiment to be made this summer aboard another Explorer. Original high cosmic ray count measurement was based on deduction rather than actual measurement.

► Navy has moved into the development stage of a new chemical aircraft designed to use high-energy boron fuels. Navy feels that adaptation of existing aircraft to high-energy fuels might be almost as costly, much less productive.

► Radically different type infrared detector which may prove to be a million times more sensitive than present lead sulphide detectors with response time of less than one microsecond is under development by Trionics Corp., Madison, Wisc. Detector, which operates on an entirely new principle, can be electromagnetically tuned to be sensitive in any portion of wide infrared spectrum.

► New family of chemical compounds that shows strong resistance to nuclear radiation and moderately high temperatures has been developed by Wright Air Development Center's Aeronautical Research Laboratory. New compound, called perarylated silanes, consists of molecules made up of silicon atoms and aromatic (Aryl) groups. Above temperatures of approximately 120C, the new chemical is a liquid, suggesting possible use in hydraulic systems or as dielectric in avionic equipment.

► Electronic gyroscopes based on new principles which require no moving parts have been proposed by three different companies to Wright Air Development Center's Weapons Guidance Laboratory. None of the three firms is a producer of conventional gyros. One of the systems may provide "fantastic accuracy," according to a WADC spokesman. All three will eliminate the need for ultra precision machining and assembly procedures, minimize deterioration of performance due to vibration. WADC also has received a proposal for a novel accelerometer which has no moving parts.

► Navy is now evaluating a Lear-developed Doppler-system altimeter unit on a Sikorsky HSS-1 anti-submarine helicopter designed to provide pilots with greater accuracy in holding position while dunking a sonar ball than that of current equipment. Unit would tie in to helicopter's automatic stabilization gear to give accurate hands-off control of the helicopter at low altitudes. Navy program calls for fleetwide installations of the gear in approximately one year after completion of tests if evaluation is successful. Helicopter carrying the gear would be redesignated HSS-1N.

Barden Precision Z96SW bearings specially designed for a gyro gimbal

BARDEN *Precision ball bearings set today's performance standards*

The Torkintegrator, a high precision torque tester, was designed by Barden for extremely accurate response to torque variations. It is one of many Barden-developed test devices used for quality control or functional testing of Barden Precision ball bearings.

For accurate gyro indications, gimbals need bearings with uniformly low and predictable torque reactions. Other demands are extreme accuracy of rotation and exact positioning of the gimbal.

All standard *Barden Precision* bearings meet critical requirements for low torque and rotational accuracy. In addition, the special purpose Z96SW has these important design features:

Barden-developed "W" retainer—to minimize torque peaks . . . eliminate "windup"

Precision flange—for precise positioning and alignment . . . rigid mounting

Shield on exposed side—to prevent entrance of foreign matter

One of hundreds of Barden "specials," the Z96SW is an example of the results that stem from working creatively with Barden engineers from the earliest design stage.

Like all *Barden Precision* bearings, standard or special purpose, the Z96SW is planned for *performance* from research and design, through quality controlled production, functional testing and application engineering.

Your product needs *Barden Precision* if it has critical requirements for accuracy, low torque or low vibration . . . if it operates at extreme temperatures or high speed.

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SPECIFY BARDEN PRECISION BALL BEARINGS FOR: INSTRUMENTS • COMPUTERS AND RECORDERS • AIRCRAFT ACCESSORIES • MACHINE TOOL AND TEXTILE SPINDLES • OTHER PRECISION APPLICATIONS

Washington Roundup

Air Defense Cuts

Air Force is cutting its air defense budget for Fiscal 1959 about 20% across-the-board from its Fiscal 1958 level. Among the programs taking cuts are Lockheed's airborne early warning plane, medium-range interceptor (Convair F-106) and air-to-ground missile (Boeing Bomarc). Cut is caused by combination of decreased USAF emphasis on defense mission and appearance of new mission requirements that necessitate larger research and development investment for future programs. Tactical Air Command also will take another cut, mainly in its Republic F-105 program.

Collision: New Demands

New demands for stricter control of airspace and more rigid traffic control procedures mounted last week in the wake of the mid-air collision over Maryland between a Capital Airlines Viscount and an Air National Guard T-33 jet trainer. Flurries of statements demanding that something be done flooded Capitol Hill in typical fashion. And Congressmen, again in typical fashion, promised more full dress probes into the mid-air collision hazard which probably will only add to the multitudinous hearings that already have been held on the subject without resulting in much more than printed confirmations of original charges that something must be done.

However, positive action came from at least one source. Meeting in Kansas City, the Airline Operations Conference of the Air Transport Assn. said plans to expand positive control of airline traffic will be advanced by one year. At present, all airline aircraft operating over 18,000 ft. are required to fly under IFR conditions.

Originally, the plan was to reduce the ceiling to 15,000 ft. on July 1 and to 10,000 ft. by July, 1959. Now the conference will propose that the ceiling be dropped directly to 10,000 ft. this July, bypassing the interim 15,000 ft. The conference also passed a resolution calling for a single system of aircraft separation coupled with a demand for rigid coordination and interchange of flight information between all aircraft.

CAA Rejection

Move by a House Appropriations Subcommittee to implement emergency air traffic control measures was rejected last week by the Civil Aeronautics Administration on grounds that such action would overload present limited airway and navigation facilities. Subcommittee Chairman Prince H. Preston (D.-Ga.) decided to appeal the rejection to President Eisenhower but was told the President's schedule would not permit an appointment to discuss the appeal. Preston later learned that the President's schedule included a round of golf at Washington's Burning Tree Country Club.

Lunar Issue

Roy W. Johnson, director of Defense Department's Advanced Research Projects Agency, is asking that military moon exploration projects be allowed to continue after the creation of a civilian space agency. He told the House Appropriations Committee:

"At the moment I am not quite sure there is military advantage in the area of the moon, twenty years from now there may be." Arguments have been made by many of the scientific fraternity that it is ridiculous to drop bombs from outer space. A bomb will not fall from that height, but presume a death ray could be created in the next twenty years.

"Getting up 500 miles in the air with a death ray might be a perfect way to use it against an enemy or an enemy's attack on you. Conversation now says that because a bomb will not drop from 500 miles, it assumes that that weapon, a bomb, twenty years from now is the only formidable weapon. We have to think of new weapons. . . . There may be weapons that will be used to far greater advantage in outer space than they would be on earth. If that happens, and if they were used against us, I think that in the year 1958 we would have made a tragic mistake if we arbitrarily said military people have no right to operate in outer space."

Defense Reorganization

What originally looked like a knock-down fight between the President and House Armed Services Committee over how the Defense Department should be reorganized has fizzled into a controversy over two points—how much authority should the Secretary of Defense have to (1) transfer and assign the combatant functions of the services and to (2) direct the administration of the individual military departments. The President wants the Secretary to have a free hand to do both. But House Armed Services Committee clamped on the shackles. Under the legislation approved by a 32 to 0 vote, any shift in a "major" combatant function would have to be submitted to Congress for review. Another committee proviso is for "separate organization" of the three military departments with the stipulation that the Secretary of Defense exercise his powers "through the respective secretaries of each department."

Hector Backs Airlines

Civil Aeronautics Board member Louis J. Hector said last week that the Board must not try to substitute its judgment for that of the airlines' if fare proposals by the industry are not unjust or unreasonable. Using a dissent in the States-Alaska fare case to express his views, Hector said he had greater faith in the airlines ability to cope with problems on the spot than "in the enterprise of governmental experts sitting in Washington." He said the statute does not provide that the Board shall set all rates for air transportation and added: "Nothing in economic history, or in the experience of regulated transportation industries, inspires much confidence in massive, detailed rate-fixing by governmental decree. When this happens, it means that true rate-making by the free play of economic forces has broken down."

Satellite Memorial

A move is under way in Congress to erect a marker at Air Force Missile Center, Cape Canaveral, Fla., to memorialize the launching of Explorer I, the free world's first earth satellite. A joint resolution calling for the Defense Secretary to provide the marker and a suitable inscription was introduced in the House by Rep. Robert E. Jones (D.-Ala.). Jones said the size of the marker probably should be considerably larger than the first U. S. satellite that was placed in orbit.

—Washington staff

Electromagnetic Warning System Studied

Proposals for 'defensive impulse' warning screen for anti-ICBM, bomber detection studied by ARPA.

By Katherine Johnsen

Washington—Defense Department's Advanced Research Projects Agency is considering proposals for a "defensive impulse screen" to repulse attacking bombers or missiles.

Testifying before House Appropriations Committee, ARPA's Chief Scientist, Dr. Herbert York, commented that proposals to accomplish this "at the moment do not look feasible," but added:

"If we were successful, it would be such an important thing that we are looking into them anyway. Some of these things are crackpot proposals but there are some proposals from competent people along these lines and we are looking into them."

Two major programs of ARPA for air defense over the coming year, York said, would be:

• **An electronic computer** system capable of separating a warhead from decoys and relaying data on its course within a one minute period. The data would be obtained at the point of re-entry of an offensive missile into the atmosphere. This would be 60 mi. up, allowing a horizontal distance of 300 mi. With a missile traveling five miles a second, this would allow a warning time of only one minute, York said.

• **An effort to obtain data on** the characteristics of a missile nose cone when it leaves the atmosphere so that it might be detected. If this could be done, York noted, the warning period would be extended from one min. to 25 to 30 minutes.

York said that phenomena surrounding the ionization of the air upon the re-entry of a missile into the atmosphere —which might be the key both to short-term warning at the point of re-entry or longer term warning at the point of entry into the atmosphere—"have not been investigated to the extent they should be.

"We want to institute an active program to find out what it is that goes on," he told members of the committee.

"The nose cone, as it comes in, probably produces some kind of electromagnetic signals by itself and one possibility is to home on those," he said. "Another possibility is to use radars which are on the ground and which reflect off of this ion column that is left by the nose cone and then you have information available on the ground which you use to steer the rocket which is going up to intercept the incoming ICBM." A second method of electromagnetic detection is being considered by the Air Force (see p. 23).

York declared that the re-entry problem of missiles has been "greatly exaggerated." He said that "it is not as hard as it has been made out to be. . . . There are a great many ways to build things so they re-enter. . . . The burn-up usually takes place, if it takes place, at a very low altitude—10 or 20 mi. up."

Identification of decoys, he said, "is an extremely difficult problem but it is not—at least as we see it now—hopeless. It could turn out that it is, but it does not appear so now. . . .

"There has to be designed a big piece of what is referred to as a logical machinery"—to relay in the course of one minute the trajectory of warheads and data on decoys.

A total of $262.7 million is earmarked for research, development and advanced production on Army's Nike Zeus air defense system, testimony disclosed. Of this, $20 million will be for basic research on the system and will be directly contracted for by ARPA.

In addition, ARPA has requested $100 million for missile defense research and development which is "not committed to any particular projects at this time," York reported. "But we have in mind a series of experimental programs designed either to develop information or develop techniques that can be used to retrofit the Nike-Zeus system. . . . We hope that much of the research that we do will be of such a nature that the items that are invented can be substituted into the Nike-Zeus system. Insofar as possible, we would like to build onto the Nike-Zeus system. If that is not possible, then there may have to be some new system that entirely replaces it. . . ."

Defense Secretary Neil McElroy added that "there are alternative ways of doing this which look as if they may be very much more effective."

York noted that there is "no agreement" on Nike-Zeus effectiveness. "It will certainly work to some extent."

The system would not be applicable to defense against bombers or Snark-type missiles, he said. "However, basic radars, basic control systems, etc., are improvements in the state of the art that can be used for building better defenses against bombers." It would be directly applicable to Polaris-type and intermediate range ballistic missiles as well as intercontinental ballistic missiles.

Highlights of other testimony by York on projects funded in ARPA's Fiscal 1959 budget were:

• **Reconnaissance satellites.** In their final version, these satellites for recording and re-broadcasting ground detail will have a gross weight of a ton to a ton and a half. ARPA has set $152 million for the program in Fiscal 1959. The program will be carried out by Air Force.

The two major problems, York said, are data-handling equipment to sift out pertinent information and development of an Atlas booster for the satellite. Preliminary test work using the

Minuteman Proposals

Washington—Deadline for formal proposals for the guidance system of the Minuteman multi-purpose ballistic missile project (AW March 17, p. 18) are scheduled to be submitted to the Air Force Ballistic Missile Division headquarters, Inglewood, Calif., by June 12. Industry firms and/or divisions that have been briefed by BMD on the guidance system requirements include:

- **Cook Electric Co.**
- **Bell Aircraft Corp.**
- **Minneapolis-Honeywell.**
- **Litton Industries.**
- **Sperry-Rand Corp.**
- **Northrop Aircraft Inc.**
- **Detroit Controls.**
- **Federal Telephone and Radio Co.**
- **Radio Corp. of America.**
- **Arma Division of American Bosch Arma Corp.**
- **General Motors AC Spark Plug Division. General Motors Corp. is making a strong bid for the over-all Minuteman project (AW May 19, p. 26).**
- **General Electric's heavy military electronics equipment department and its missile-ordnance department.**

The ballistic missile division already has asked the Pentagon for $250 million to cover the Minuteman project's assembly and test phases, which probably would extend over a four-year period.

Thor intercontinental ballistic missile to check out some of the components is planned.

Noting that low-orbiting satellites will obtain the best data, York pointed out that at an altitude as low as 100 mi. the satellite would have a life of only a few hours. Although the first applications of the reconnaissance satellites will be to obtain strategic information, York said that "eventually we hope to be able to develop them to the point where they are tactical and can give early warning."

• **Man in Space.** A project to put a chimpanzee into orbit in a satellite within 12 to 15 months is being studied.

York said he would recommend against attempting to put a man into space within the next year. It will take ARPA "several months," he added, to evaluate numerous proposals for man-in-space programs that have been made by the services, industry and NACA.

York conceded that Russia may well make an early try at placing man in space. Aside from taking the risk, he pointed out that their booster capability is markedly in advance of that of the U.S.

• **Special engines.** ARPA has allocated $15 million for development of a million pound thrust chemical engine and $5 million for special high performance engines to go on top for use in satellite and lunar missions.

• **Space components.** With a funding of $10 million, ARPA plans development of new chemical batteries, nuclear batteries, nuclear reactors, radioactive isotope heat sources, solar batteries and solar boilers for batteries.

• **Solid propellants.** York said ARPA wants to take "a broad brush look at all the reasonable possibilities" for development of solid rockets that would be used in five years. A total of $20 million is earmarked for the program. Army's Pershing and USAF's Minuteman solid-propellant ballistic missile projects will continue under the services.

• **Lunar probes.** ARPA is setting aside funds for two Army and three USAF lunar probes during the coming year. Army satellites will carry heavy payloads of cosmic ray equipment. USAF's satellites will be launched by Thor Vanguard systems with a third stage to be developed. Navy has been assigned development of a mechanical scanner sending electrical signals back to the earth for decoding. York said that "the hope would be to get a first look at the other side of the moon."

All of the probes will be orbiting operations with no attempt made at a moon strike. York estimated the odds for a successful moon impact at only 25%. Barring malfunctioning, he said, the chance of successfully orbiting the moon is about 75%.

House Space Agency Legislation Near to President's NASA Plan

By Ford Eastman

Washington—Legislation to create a powerful civilian space agency similar to the one proposed by President Eisenhower was reported to Congress last week by the House Committee on Astronautics and Space Exploration.

Rep. John W. McCormack (D.-Mass.), committee chairman, said he hoped the House would take action on the measure by this week. He added that the agency, if properly run, could be a major factor in helping the U.S. surpass the Russians in space achievements.

The Senate Special Committee on Space and Astronautics is preparing its own version of a national space agency and expects to report the bill out sometime this week.

The House bill, approved by a unanimous vote of the space committee, calls for the establishment of a National Aeronautics and Space Administration headed by an administrator and a 17-man advisory committee. The present National Advisory Committee for Aeronautics would form the nucleus of the new agency.

Changes in Bill

Although the House bill embraces the basic concepts of the administration proposals, it differs in several respects from the suggested bill submitted by the Budget Bureau. Major changes made by the space committee include:

• **Places clean emphasis,** in a Declaration of Policy, on outer space activities devoted to peaceful purposes and the general welfare.

• **Upgrades status by changing name** proposed from National Aeronautics and Space Agency to National Aeronautics and Space Administration and changing the title of director to administrator. Annual salary of the administrator would be $22,500.

• **Provides for the appointment** of a deputy administrator at a salary of $21,500 and a general counsel at $21,000 annually.

• **Establishes within the space** administration a division on military application and a division on nuclear application and permits formation of other program divisions to provide for the greatest possible coordination of the administration's activities with related scientific and other activities of public and private agencies and organizations. Directors of each division will receive $19,000 annually.

• **Calls for nine members of the** 17-man committee to be designated from government departments or agencies, including at least three from the Defense Department. The original bill proposed at least one Defense member.

• **Establishes a Military Liaison** Committee to represent Defense Department, Army, Navy and Air Force on matters relating to military application of research and development activities and to be responsible for exchange of information between the two agencies.

• **Establishes an Atomic Energy** Liaison Committee which would operate along the same lines as the military committee on matters relating to atomic energy. The chairmen of the two committees would be appointed by the President and receive $20,000 annually.

• **Establishes a Joint Congressional**

Space Agency Need

Washington—Urgent need for creating a strong national space agency and moving forward with a sound program was emphasized in the House Committee on Astronautics and Space Exploration report by comparing Russian achievements with those of the U. S.

"Whether judged by civilian or military standards, the crucial battle of space is one in which the Soviet scientists and technicians do not need to catch up," it said. "Most authorities agree they are ahead of us.

"If U. S. plans for development work are carried out, an appreciable period of time will be required to reach the level of present Soviet accomplishment. The difference in achievements is essentially the difference in weight between the Soviet Sputniks and the American satellites, Explorer and Vanguard. Weight is an accurate index of the rocket thrust available for both space exploration and the purely military ICBM's. Furthermore, it provides ability to lift complex instrumentation or explosives, *or* man himself into space.

"Our three successful launchings to date have put 65 lb. of payload into orbit. Their three have put up 4,223 lb. of payload in orbit. The handwriting is in the skies. It will take time, money, public understanding and dedication to erase."

Committee on Aeronautics and Outer Space to be composed of nine members of the Senate and nine of the House.

• **Protects the government's interest in** any invention or discovery made under contract or other arrangement in carrying on the functions of the agency.

• **Calls for the administrator to engage** in a program of international cooperation in carrying out space activities and the peaceful application of the results.

In a report that accompanied the bill, the committee said the President's proposal to create NASA was a good step in the right direction. It added, however, that evidence received during the hearings indicates that the bill needs the guidance of further legislation.

The structure of the organization should be strengthened and widened, the committee said. It added that its command functions should be far more securely established and its relationships with other agencies more specifically set forth if there is to be the delicate balance between sure authority and free inquiry.

The report added that establishment of the agency is not simply a matter of organization. It will, it said, "in the end stand or fall on the quality of the men who direct it, therefore, the selection of leading officials for the agency is a matter of extreme importance."

In the planning and operation of space programs, the report said, an immediate problem has been the relationship of the civilian to the military. It added that no easy separation of military and civilian uses of space technology is possible at this stage and that the alternative is to link the two efforts.

"This makes it doubly urgent," the report said, "that coordination and cooperation between the Defense Department and the new agency be thoroughgoing and specifically provided for by law, not left to the chance good intentions of particular administrators."

The committee pointed out that the Defense Department's Advanced Research Projects Agency has primarily a military mission to perform in space and should not be restricted in this respect. It added, however, that the Defense Department cannot be the sole arbiter of what is military and what is civilian when particular activities are in dispute

The committee urged that such disputes be reconciled at least at the level of the National Security Council with both the military agency and the national civilian agency being given an equal chance to be heard. "The National Astronautics Agency must be more than just a repository for projects ARPA is not interested in," the committee said.

The establishment of a national space program is a matter of the highest urgency, the committee said, both for reasons of immediate national defense and to ensure that in the long run outer space is effectively utilized for peaceful purposes.

"The national space policy is too important to leave exclusively to military authorities or to scientists alone," the report said. "It must be coordinated at the highest levels of government with other aspects of our military, foreign, technological, and economic policy."

Control of the program, however, should be in civilian hands, the committee added, and oriented toward the interests of the nation.

Four Objects Reported in Sputnik Orbit

Washington—At least four separate objects are reported to be in the Sputnik III orbit by U. S. observers. The objects are:

• **Instrumented satellite.**

• **Final stage rocket engine.**

• **Nose cone.**

• **One and possibly more,** lightweight bodies with a minimum area of several square feet.

Russian announcements have confirmed the existence of these bodies which they have termed "shields," without any explanation of their purpose.

U. S. stations in Florida, California and Texas reported approximately one week ago that at least one object, which was barely visible and had about the same luminousity as a star of the seventh magnitude, was following the Sputnik III instrument carrier.

Other Russian information concerning the new Sputnik checks well with data being gathered by U. S. agencies. Moscow reports that its apogee is 1,168 mi., its perigee is 150 mi., total weight of its instrument carrier is 2,926 lb. Its inclination to the equator is 65 deg., and the period of its orbit is 106 min.

A spokesman for the Smithsonian Institution Astrophysical Observatory in Cambridge, Mass., said all of these figures are very close to the first estimates reached by his organization.

He added that the final stage rocket when it appeared over Boston at about 500 mi. altitude had the brightness of Jupiter and was approximately the same size as the final stage rocket of Sputnik II. The rocket was tumbling, completely rotating every seven seconds. It was estimated that the rocket would be preceding the instrument carrier by half an hour by the end of last week.

The Smithsonian Observatory, which calculated that the gross weight of Sputnik II was between 7,000 lb. and 8,000 lb. in its earliest estimates, indicates that the total weight in the Sputnik III orbit is somewhat greater.

This information checks with U. S. military sources who believe that the same rocket system was used to launch both Sputnik II and III even though the payload of the latter satellite is around 1,800 lb. greater. (See p. 50.)

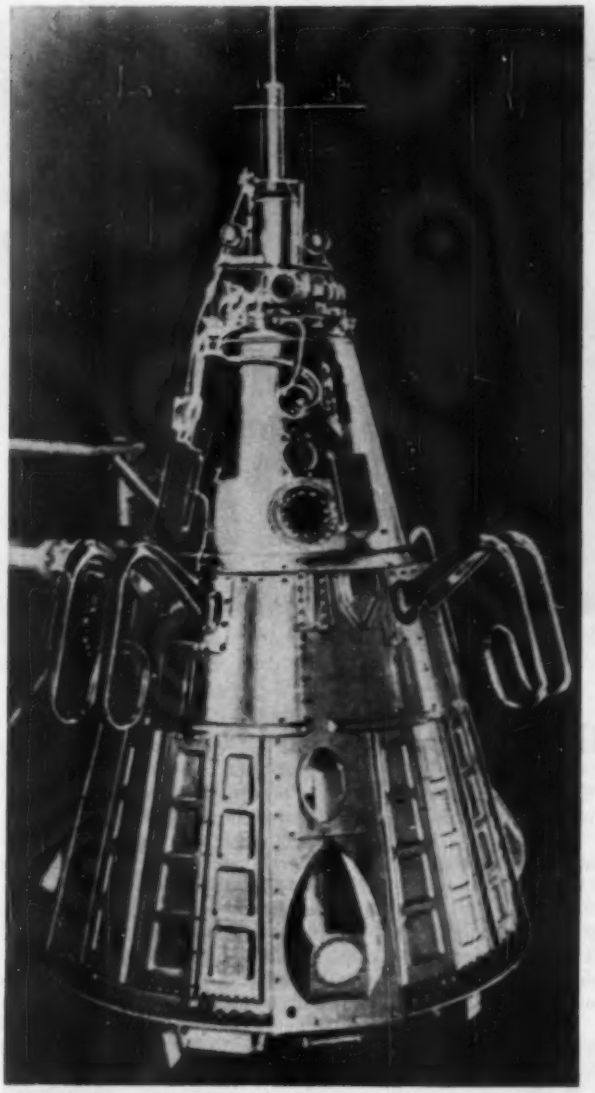
Soviet politicians, for the first time, drew frequent and sometimes biting contrasts between the Russian satellites and the smaller U. S. vehicles. Soviet Premier Nikita Khrushchev, for instance, called the U. S. Explorer and Vanguard satellites "oranges" and said that many "oranges" would be needed to do the work of one Sputnik III.

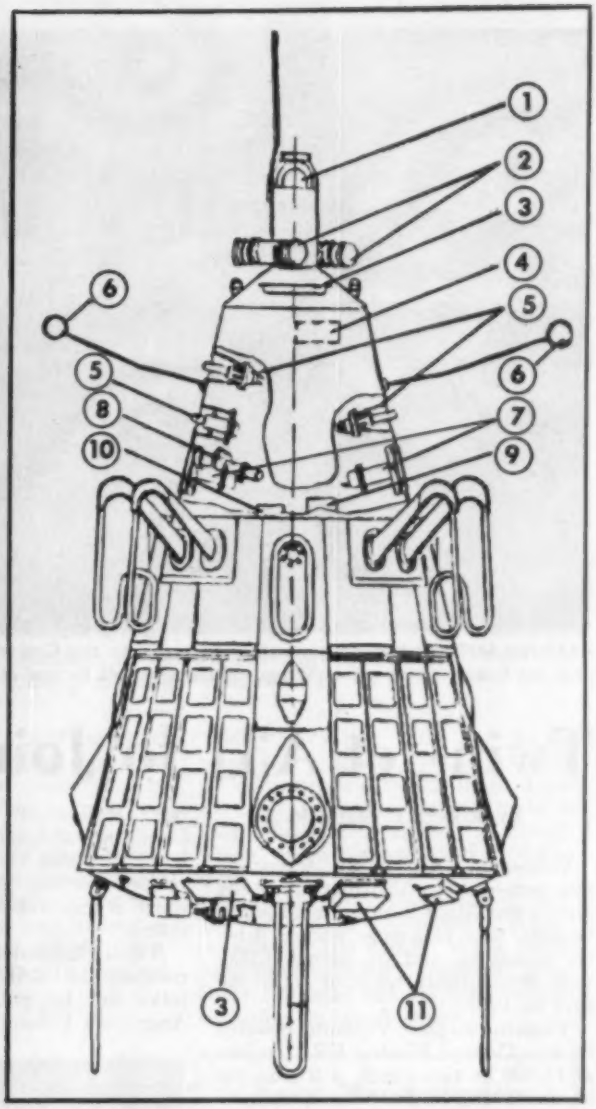
Russian scientists made a large number of statements regarding their new satellite and its instrumentation but refrained from comparing it with other equipment now in orbit.

Academician Leonid Sedov, head of the USSR Academy of Sciences space program, was quoted as saying, "The new Sputnik . . . could easily carry a man with a stock of food and supplementary equipment. However, such an experiment would be premature. Before it is attempted, more knowledge must be gained about the conditions of man's existence in cosmic space, and the basic problem of the return to earth must be solved."

In a radio address, Vladimir Vladimirovich Belousov, deputy chairman of the Soviet International Geophysical Year committee, said, "the telemetric system for the transmission of results has been improved considerably, as compared with the first two satellites. . . Also very important, is the special installation to regulate the temperatures inside the satellite. This is important for securing normal uninterrupted work of the instruments. . . . The improvement of the means of observation of the satellite in flight will allow us to calculate the satellite's orbit with greater precision and detail and to register all of its irregularities indicating the distribution . . . of gravitation. That will bring more precision into our ideas as to the internal structure of the earth."

Belousov's reference to an improved system of regulating the internal temperature of the satellite is tied in with a recent statement by Academician Alexander N. Nesmeyanov in which he indicated that Laika, the dog in Sputnik II, died from heat prostration. This also may mean that the instrumentation in the satellite malfunctioned because





SPUTNIK III components include (1) magnetron, to measure gravity (2) photo multipliers to measure corpuscular irradiation of sun (3) solar batteries at top and bottom (4) device to register photons in cosmic rays (5) magnetic ionized manometers (6) ionic traps (7) electrostatic fluxmeter (8) mass spectrometer tubes (9) apparatus to register heavy nuclear effect in cosmic rays (10) device to measure intensity of primary cosmic irradiation and (11) micro-meteor recorders. Photo and drawing appeared in Pravda.

of the excessive temperature rise.

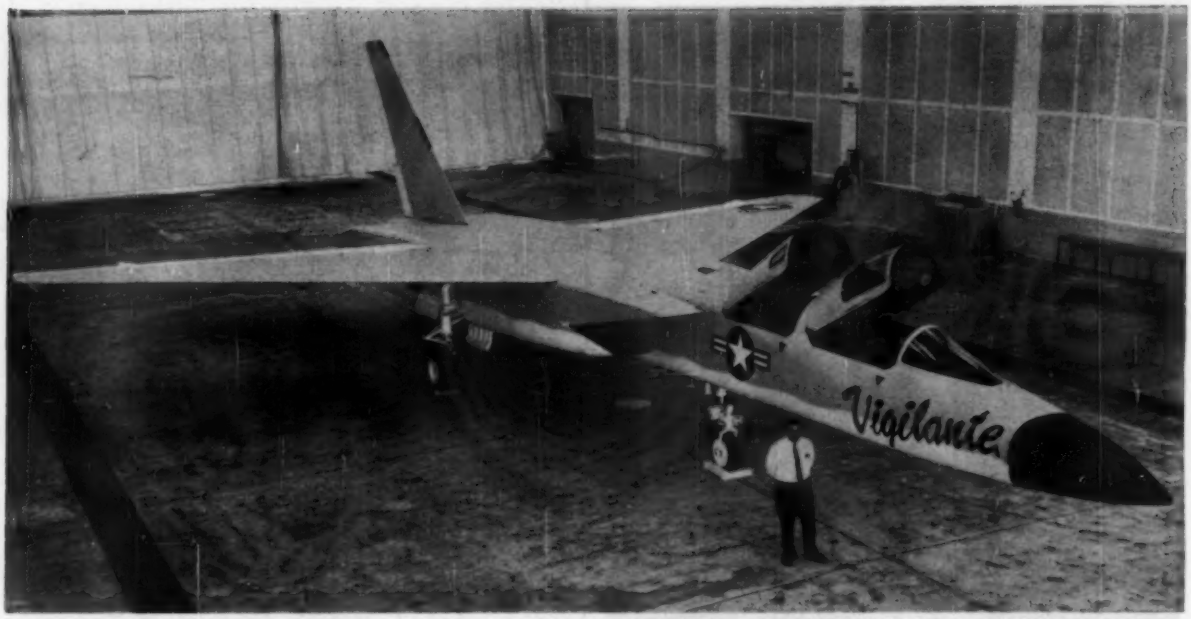
Tass, the Soviet news agency, reported that Sputnik III has a thermo-regulator system which ensures constant temperatures inside the satellite and is a great improvement over the systems in the first two Russian satellites. The operation of the system is described as depending on the controlled circulation of nitrogen inside the instrument carrier and changing coefficient of surface radiation through an external coating and sixteen separate sections of automatic regulating blinds installed on the outer surface.

The description of the instrumentation in Sputnik III, which Tass has labeled a laboratory in space, does not seem to be an exaggeration. It includes most of the equipment programmed for the Vanguard program. Power is supplied by chemical and solar sources, but the Russians have not indicated which instruments, if any, depend completely upon the chemical batteries and would cease to function in a relatively short period. The list of instrumentation in Sputnik II includes:

- **Micrometeorite collision counter.**
- **Magnetometer.**
- **Photo-multipliers to measure** solar corpuscular radiation.
- **Traps to measure concentration** of positive ions.
- **Mass-spectrometer to determine** the atomic and molecular weight of the elements and the compounds in space.
- **Electrostatic fluxmeters to measure** the electric charge and the tension of the electrostatic field.
- **Cosmic ray counters.**
- **Temperature measuring devices.**
- **Pressure transducers.**
- **Radio beacon for tracking purposes.**

This collection of instruments is controlled by a program timer that switches them on and off in precise sequence so that their measurements can be properly related to the satellite's position. The Russians describe their multi-channel telemetering equipment as an improvement over their previous equipment.

The system of optical tracking used for Sputnik III is similar to one tried during observations of Sputnik II. It makes use of electronic-optical converters and provides better photographs than are available with the best optical equipment.



A3J VIGILANTE, in Mach 2 speed class, is powered by two General Electric J79-2 engines of 15,000 lb. thrust each; carries crew of two: pilot and bombardier-navigator. Wings, tail and nose fold for ease of carrier handling.

Twin-Jet A3J to Join Fleet in 1961

By Robert I. Stanfield

Columbus, Ohio—North American's new twin-jet A3J-1 Vigilante will be the Navy's first Mach 2 carrier-based attack bomber, with long-range nuclear delivery capability, and its second 1,000-mph.-plus aircraft when it joins the fleet in 1961.

Tandem two-place Vigilante, powered by two General Electric J79-2 engines of 15,000 lb. thrust each, will gross out at about 50,000 lb. This is approximately 20,000 lb. less than the Douglas A3D-2 Skywarrior it will replace.

Inertial Guidance

In the works are plans to increase Vigilante's performance capabilities via rocket power, AVIATION WEEK was told.

All-weather airplane is Navy developed except for its self-contained inertial guidance navigation system, a derivative of that used in North American's Navaho surface-to-surface intercontinental missile, and developed by North American's Autonetics Division at Downey, Calif.

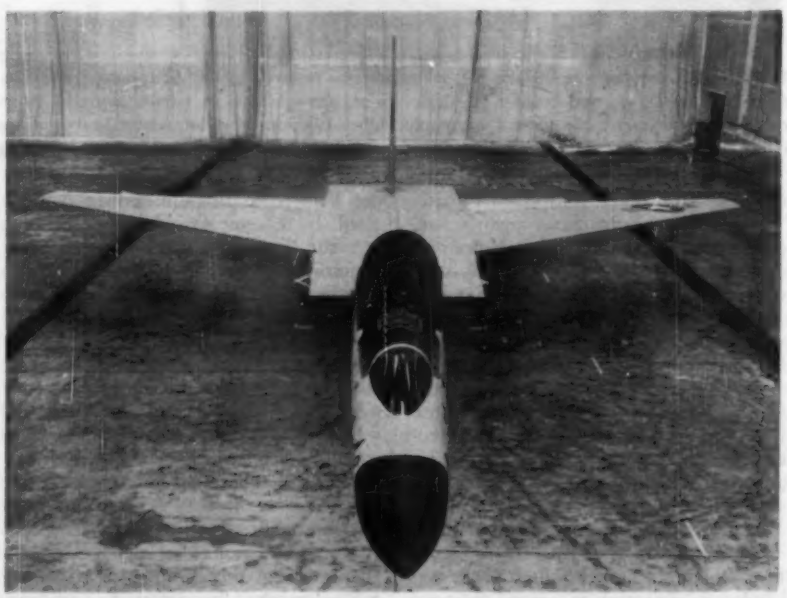
A3J will launch its atomic stores by firing them from a rearward facing tube in the fuselage, thus eliminating flow problems met in conventional launchings at supersonic speeds (AW Mar. 17, p. 15). Minneapolis-Honeywell is a contractor for the delivery system.

A3J's will use AN/ASB-11 or AN/ASB-12 radar bombing system, consisting of K-band radar developed by Convair Division of General Dynamics Corp., optical bombsight developed by Eastman Kodak Co. and computer developed by the Autonetics Division which is responsible for integrating the system.

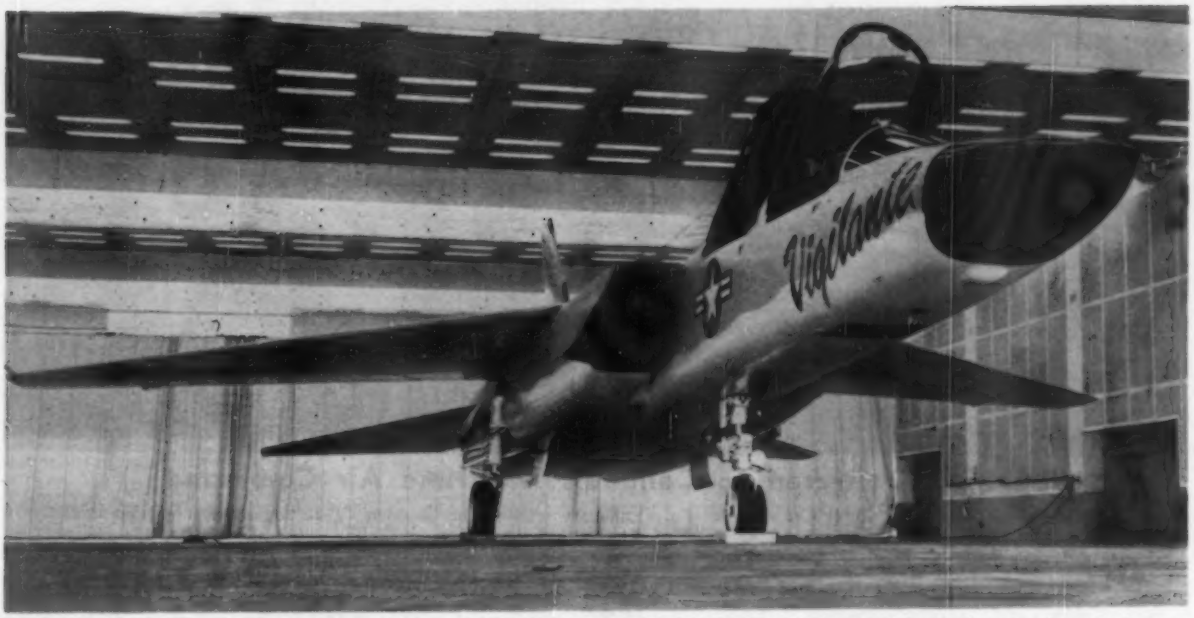
A3J, in estimates of its capabilities compared to USAF's B-58 Hustler, was rolled out for public view at North American's Columbus division. Immediately afterward it was torn down for instrumentation installation. At the rollout, Adm. Arleigh A. Burke, chief of naval operations, termed it a precision instrument, highly effective at both high and low altitudes.

Pointing up the value of manned aircraft, Admiral Burke stated "It takes a man to think. A missile can't."

Atomic weapon carrier is also geared



A3J's nose runs well ahead of tricycle gear which, with flaps and speed brake, is actuated by compressed nitrogen. Radar bomb system will be AN/ASB-11 or AN/ASB-12



VIGILANTE'S wings are swept back about 30 deg. Lateral control is maintained by mid-chord slot deflector flaps in place of ailerons. Leading edges are droopable. Inertial guidance navigation system is derivative of that used in Navaho missile.

for brush fire and conventional weapon delivery. Two external pylons, hung on wings, will carry missiles, rockets or fuel.

Wing span of A3J is 50 ft. Length is 70 ft. Over-all height is 20 ft. Wings, tail and nose fold for ease of carrier handling.

Wings are high and swept back about 30 deg. Vertical and horizontal stabilizers are full movable slabs. Lateral control is maintained by mid-chord slot deflector flaps in place of ailerons. Wing is equipped with droopable leading edges. Flaps with boundary layer control, used in conjunction with spoiler-deflectors, enhance low-speed flight characteristics.

Long slender nose runs well ahead of tricycle gear which, with flaps and speed brake, is actuated by compressed nitrogen (AW July 8, 1957, p. 23). Main wheels are 36 by 11 in.; nose wheel is 26 by 6.6 in. Brakes are multiple disc; gear shock struts are air oil.

Powerplants

Vigilante's two 17-stage, axial flow, single-rotor J79-2 powerplants weigh 3,200 lb. each. Frame size is 32 in.; over-all length, 204 in. Pressure ratio is 12:1. First six stator stages and inlet guide vanes are variable. Air inlet surfaces are anti-iced via air from compressor discharge.

Rotor consists of thin webbed discs and spacer rings bolted together with blading attached to rim sections by conventional dovetails. Three-stage turbine wheels are coupled to compressor rotor by a conical shaft.

J79's power control system has two separate fuel systems: main fuel system is controlled by main fuel controller which is a flow controlling type unit; afterburner fuel system is controlled by an independent afterburner fuel controller.

Integrated and synchronized composite system also consists of nozzle area control system and variable stator control system (integrated with main fuel control). Hydraulic and electric power required to operate system is supplied by engine.

Speed Capability

Speed and altitude capabilities of A3J are evident, as J79s also power supersonic Grumman F11F-1F Tiger and USAF's Convair B-58 Hustler and Lockheed F-104A Starfighter. Latter only recently set world records for altitude (91,249 ft.) and speed (1,404.19 mph.).

Navy feels that Vigilante, with two J79s, "could well take the altitude record from comparable aircraft with one J79" (the Starfighter).

A3J will begin preliminary flight testing in August. Because of limited runway length at Port Columbus (8,000 ft., which North American plans to increase an additional 2,000 ft.), preliminary tests will be run at Strategic Air Command's Lockbourne AFB, 10 mi. south. Airplane will later move to joint Navy-USAF-contractor flight test facility at Palmdale, Calif.

Airplane's air-to-air refueling is accomplished via extendable probe located on the left side of fuselage in pilot's area. Pressure fuel filler is located on bottom of fuselage, between main gear.

Range of the Vigilante was said to be "twice as far" as early AJ1 Savage, which had a tactical radius approximating 500 naut. mi. (tactical range—1,000 naut. mi.). A3J also was said to be at least "three times as fast" as Savage, whose speed approximated 400-plus mph.

Contracts for development of A3J, and production of initial quantity, amount to $200 million. While North American Columbus is prime contractor, about 200 small business firms are participating in development.

Navy Man-in-Space

Washington—Defense Department's Advanced Research Projects Agency was asked last week to approve Navy plans for a man-in-space program. Prime contractors for the program, as outlined to ARPA, would be Goodyear and the Martin Co. Navy estimated the cost of getting the project underway at $600,000.

The Martin-Goodyear project is one of several manned space programs which the Bureau of Aeronautics has had under consideration for more than a year. All the projects call for sea-based vehicles that are primarily weapon systems. Sea basing, the Navy contends, would give the systems additional mobility for security purposes and provide an additional safety factor. Water landings, a Navy spokesman pointed out, would allow a wide latitude for error on the part of the crewman or ground controllers in attempting to return the vehicle to a pre-determined point.

CL-28s Delivered to Canada's Maritime Air Command

Canadian Maritime Air Command, Royal Canadian Air Force, officially received the Canadair CL-28 Argus anti-submarine aircraft in a ceremony at Greenwood, Nova Scotia, an RCAF station. Five CL-28s were present for the ceremony. Ten of the aircraft have flown to date. Chief of the Air Staff, Air Marshal Hugh L. Campbell officially presented the first aircraft to Air Commodore Martin Costello, air officer commanding the Maritime Air Command. The CL-28s will replace Lockheed P2V Neptunes now used at Greenwood.

West Germany to Buy Fiat G.91 Fighters

Bonn, Germany—West Germany intends to buy 50 Fiat G.91 light-strike fighters from Italy.

Fiat G.91 won a five-plane NATO competition last year and has been recommended by NATO for incorporation in its West European air forces. A light-strike aircraft also has been designated a joint project by the recently formed German-Italian-French armaments pool. But whether the French, who fielded four of the five entries in last year's trials, would agree to an advanced version is an open question.

In view of West Germany's pilot-shortage, it seems likely that the Luftwaffe will want an advanced design of the G.91 rather than the current model. A photo-reconnaissance version of the G.91 also is under consideration.

Sud Builds Monoplane For Colonial Service

Paris—First flight of Sud Aviation's twin-turboprop colonial support plane the Voltigeur (Scout) is expected to take place the end of this month.

Aircraft is powered by two Turbomeca Bastan turboprop engines of 650 hp. each.

A two-seater, the Voltigeur is being developed under special French overseas requirements which already have produced such prototypes as Morane-Saulnier's Epervier and SIPA's 1100. The Epervier is powered by one Bastan, the SIPA aircraft by two Pratt & Whitney R-1340 600 hp. engines (AW May 19, p. 79).

Sud Aviation's entry into the colonial aircraft competition is a monoplane with low wing and conventional type single fin. Wing span is about 60 ft., length about 41 ft.

Cruising speed of the Voltigeur will be just under 300 mph. Company says a civil version of the aircraft will carry about seven passengers.

French Epervier Makes First Flight

Morane-Saulnier 1500 Epervier two-seater colonial police plane has made its first flight at Bretigny Test Center. Designated Sparrowhawk, aircraft is powered by 400 hp. Turbomeca Marcadau turboprop engine; second prototype will have Turbomeca Bastan 700 hp. turboprop using three-bladed propeller. Epervier can take off in 400 ft., cruise at 200 mph. Maximum range is 500 mi. Aircraft weighs 3,850 lb. empty, has gross weight of 6,050 lb., can carry two Nord S-11 air-to-ground missiles (AW April 14, p. 33).

FCC Action Threatens to Delay Use of New Doppler Navigators

By Philip J. Klass

Washington—Recent Federal Communications Commission action in withdrawing certain frequencies from civil air navigation use, which threatens to delay use of new Doppler auto-navigators and adversely affect their performance, has drawn strong protests from airlines and a number of avionics manufacturers, both here and abroad.

FCC action also may handicap the design of an air collision avoidance system by Bendix Radio.

Petitions urging FCC to reconsider have been filed by Aeronautical Radio Inc. (Arinc), Air Transport Assn., Bendix, Collins Radio, Radio Corp. of America and Douglas Aircraft Co.

Timing of FCC action in reallocating the 8,500 to 9,300 mc.; 9,500 to 9,800 mc., and 420 to 450 mc. bands to the military for "radio-positioning devices," both mobile and fixed, and its references to "vital national defense considerations" and the "space age" suggest that the frequencies will be used for ballistic missile defense.

Why Objections

All U. S., Canadian and British Doppler systems being developed for airline use, and many of the existing military Doppler navigators, are designed to operate at 8,800 mc. or 9,800 mc. Only the military Doppler systems developed by Ryan Aeronautical and General Electric operate in the 13,000 mc. band which the commission has suggested as an alternative to the newly withdrawn frequencies.

Airlines and manufacturers object not only because FCC's action will force major redesign of civil sets, delaying initial use by nine to 18 months, but say the higher frequency will seriously degrade performance because of increased atmospheric attenuation and aircraft installation problems.

The commission has authorized temporary Doppler radar service at 8,800 mc. "until moved to a frequency band allocated to aeronautical radio-navigation" but cautions that civil users must "accept any harmful interference that may be experienced from (military) radio-positioning devices."

Although some airline and equipment manufacturers privately say they are not too worried about interference problems, they are not willing to invest heavily in Doppler systems designed for 8,800 mc. if they can be rendered obsolete on short notice by FCC.

Airlines point out that FCC action is contrary to international standards contained in the Atlantic City Radio Treaty of 1947—to which the U. S. is a signatory—which allocates 8,500 to 9,800 mc. for joint-civil military air-navigation use.

Commission says that pressing defense needs require immediate U. S. action without waiting for the next International Radio Conference scheduled to be held in Geneva in July, 1959, at which time participating countries will propose desired revisions to present frequency allocations.

Moral Obligation

If the 1959 Geneva conference should fail to accept a U. S. proposal to revise international standards to match FCC allocations, foreign carriers could insist upon their right to use 8,800 mc. Doppler systems on flights to this country. The U. S. might then be morally obligated to attempt to minimize the interference problem, but the treaty reserves the right of each country to use a spectrum within national boundaries for defense purposes as it sees fit.

State Department hopes to obtain an exchange of international airline views on FCC changes prior to preparing an official U. S. position for the Geneva conference.

This will be accomplished at an International Civil Aviation Organization meeting in Montreal in August, where the subject will be a hot agenda item.

Collision Avoidance

The commission action in reallocation of 420-450 mc. band for military use (except for amateur service), hits at the cooperative-type of automatic collision avoidance system which Bendix Radio is developing as result of its Air Force sponsored study of the problem.

The Arinc-ATA petition cites performance figures which indicate that system effectiveness would be greatly reduced if it must operate in higher frequency bands of 1,600 mc. or 4,300 mc.

Office of Defense Mobilization, coordinating agency through which all government agencies deal with the FCC on frequency allocation matters, says neither it nor FCC was aware of the

G.E. Forms Transport Engine Unit

New York—General Electric Co. has created a new commercial jet engine organization within the framework of its Aircraft Gas Turbine Division at Evendale, Ohio. Neil Burgess, formerly project director on the J79 turbojet development, will head the new group.

Initially, the commercial engine organization will handle marketing, field service and flight test aspects of the G.E. airline sale program, but eventually it will expand to cover engineering of new developments, manufacturing, sales and service. Headquarters will remain in Evendale.

The commercial engine operation will include the CJ805 turbojet, the turbofan engine development and a new family of engines aimed at supersonic cruise performance. It also will initially offer airlines using the CJ805 turbojet in the Convair 880 transport an overhaul service at Evendale. G.E. feels that some airline will eventually want to set up its own overhaul facility but is offering the Evendale facilities that now do military overhaul on the J47, J73 and J79 engines to bridge the gap until the airlines establish their own facilities or for possible pool overhaul operations for a number of small airlines that do not want to establish their own overhaul shops.

G.E. has completed its first 150 flight test hours on the commercial version of the J79 in the XF4D Navy fighter and will have two of these engines flying in a modified B-66 twin jet bomber by early summer.

G.E. now has several of its turbofan engines running on the test stand at Evendale and is shooting for CAA certification of the engine by the middle of 1960. It is offering a retrofit of regular CJ805 commercial engines to the aft fan version after overhaul for a fixed price to airlines. But G.E. feels that the maximum benefit from the turbofan development will come in new versions of the Convair 880 designed to take full advantage of the engine's advantages.

For example, the 35% increase in maximum takeoff thrust from the aft fan version will allow greatly increased fuel loads which will require increased tankage capacity in the aircraft. It also will permit a longer fuselage with increased passenger capacity. G.E. plans to make a major selling point of the flexibility of the aft fan's advantages offering either a 10% lower fuel consumption at equivalent cruise speeds to a straight turbojet engine or up to 18% fuel economy increases with a lower cruise speed on less competitive routes.

The G.E. commercial engine operation will be headquartered in Evendale, utilizing the Aircraft Gas Turbine Division's Geneva office for European operations.

Amphibious Turbine-Powered S-62 Makes First Flight

First flight photo of Sikorsky's new 10-12 passenger S-62 shows amphibious helicopter prototype coming in for a water landing on its specially designed flying boat hull, which adds less weight than use of conventional flotation gear. Powered by a single General Electric T58 engine, company-financed S-62 will have a gross weight of 7,500 lb., useful load of 2,950 lb. Cruise speed is reported as 105 mph. Initial flight took place less than a year from date decision was made to start design work; much time was saved because S-62 uses many of piston-powered S-55's proven components, such as main and tail rotor heads and blades; main, intermediate and tail gear boxes, shafting and major portions of control and hydraulic systems. Sikorsky notes that current operators of commercial and military S-55s could turn their ships in for retrofit to more advanced configuration at considerable savings in costs. Formal rollout was last week.

Bendix program spectrum needs at the time the reallocation decision was made.

In some ways, the present conflict is reminiscent of the earlier Tacan-DME controversy. Some airline representatives feel the military is being high-handed in its demands. Because of security, airlines and equipment manufacturers are handicapped in learning about the nature of military needs and the possible types of interference that may be encountered if Doppler systems operate in 8,800 mc. band.

Warning of Problem

However, an Office of Defense Mobilization spokesman says that airline and avionic manufacturers' representatives who attended the December meeting of the government's Interdepartmental Radio Advisory Committee (IRAC) were warned that an interference problem existed in the 8,800 mc. band and that the civil Doppler system should be shifted to another frequency. Despite this warning, Arinc decided to proceed with 8,800 mc. development, the ODM spokesman said.

An Arinc memo dated Dec. 17 to members of its Airline Electronic Engineering Committee reporting on highlights of IRAC meeting concluded that Doppler radar manufacturers "are not alarmed by potential interference from (military) ground or airborne radars . . . (because of its) narrow-band nature."

If interference did occur, while an aircraft was passing over a high-power radar, it would interrupt service only briefly, Arinc concluded.

Arinc, ATA and equipment manufacturers say they were shocked by the recent FCC regulation, coming without prior warning or open hearings. FCC had been granting one to five-year licenses to airlines and aircraft manufacturers for operation of Doppler systems at 8,800 mc. Then, on April 18, FCC published its order with changes made effective as of April 16.

Lockheed Says F-104 Can Set New Record

Los Angeles—USAF's Lockheed F-104 exceeded 1,500 mph. twice in practice runs for its 1,404.19 mph. record speed run and officials are convinced the airplane can easily break its own record if a new try is approved. F-104 can exceed 1,500 mph. without much difficulty. Problem that invalidates many speed runs is difficulty of staying within tight altitude limits required by Federation Aeronautique Internationale at high speed.

Capt. Walter W. Irwin of Hamilton AFB, flew the General Electric J79-powered Starfighter from USAF Plant 42 at Palmdale, Calif., in an officially recorded speed run over nearby Edwards AFB, breaking the old record of 1207.6 mph. by nearly 200 mph. The earlier record was set by USAF McDonnell F-104A Voodoo fighter.

Capt. Irwin is a member of the 83rd Fighter-Interceptor Squadron, USAF's first operational Mach 2 squadron. The squadron is the first to hold both the world's speed and altitude records. Last week the squadron's operations officer, Maj. Howard C. Johson, recaptured the world's altitude record for the United States when he flew an F-104 to 91,249 ft.—more than 2 mi. higher than the French Trident .06 record.

The speed record, Irwin said, came without benefit of unusually low temperatures which yield greater thrust. "Because of the tight restrictions imposed by the National Aeronautic Assn. on record speed flights, my entire concentration was on holding an exact altitude over straight course 10 mi. long." He held the F-104 to a less than ¼% deviation upward or downward over the measured course.

Taking off from Palmdale, Irwin climbed to 40,000 ft. over Gorman—half way between Los Angeles and Bakersfield, and headed eastward, accelerating into the measured course. After completing the timed run, he made a procedure turn near Victorville and came back over the measured course in the opposite direction to cancel wind effects. The eastward run was clocked at 1,456.41 mph. and the westward one at 1,342.97 mph. Total time in the air was approximately 20 min. The two speed runs lasted about 20 sec.

A 14-man National Aeronautic Assn. team headed by Bertrand Rhine, senior

MASS RETALIATION—USAF-Northrop Snark SM-62s, world's first and only *proven* intercontinental guided missiles, can reach any military target on earth from U. S. bases. No human crew is carried *and no defensive strategy yet conceived can stop the Snarks in mass attack!* With deadly accuracy their hydrogen warheads can annihilate an aggressor's defenses, his airfields, his missile sites, his arsenals. They can open paths across an enemy's homelands for the crews of our manned bombers to follow, to attack, and return. Today, Snarks are being delivered to our Strategic Air Command, complementing SAC's powerful striking forces. The Snark—our *one* fully developed intercontinental guided missile—is in limited production. Its cost is but a fraction of that of any other intercontinental air weapon under present test or development. America and the free nations of the world need the full defensive and retaliatory power of the Snark and they need it now.

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Two J85s Power UTX Prototype

North American's prototype UTX Saberliner four passenger utility jet transport powered by two General Electric J85 turbines installed aft of swept wings was rolled out last week. Engines produce about 2,000 lb. thrust each. Wings have five slats on each wing, shown in droop position above. Nose spike is VOR antenna.

NAA West Coast representative, followed the flight with precision tracking and timing instruments. Three referees flew in T-33 aircraft at about 40,000 ft. for visual observation to assure compliance with the stringent requirements of the 46 nation Federation Aeronautique Internationale. NAA serves as U.S. member of the FAI for the recording of aviation records. The team processed data on each flight for about four hours before certifying the record to Air Force officers.

Lockheed Contract Sets Labor Pattern

Los Angeles—Labor peace in southern California's aircraft industry seemed virtually assured last week as last of major contractors either had signed new contracts or had contracts to be submitted to memberships for approval.

General pattern followed that set by Lockheed's California Division two weeks ago in that contracts provided for increases in wages, changes in seniority rules, job security, job definitions and holidays. Contracts generally were for two years, with provisions for wage increase at start of second year.

Signed contracts existed with Lockheed and North American Aviation, Inc. Douglas Aircraft Co. had contracts with its employes represented by United Auto Workers union, while International Assn. of Machinists employes were to vote on basically similar contracts. Convair Division of General Dynamics Corp. had agreements for Fort Worth, San Diego divisions. Lockheed Georgia and Missile Systems Divisions had concluded negotiations.

Convair's Pomona Division still had a strike in progress, but company reported a steady increase in number of employes represented by the bargaining unit who returned to work anyway. By late last week, division worker strength stood at 84½% of normal, up steadily from the 75% level which obtained when strike was called. Negotiations were suspended but were expected to resume.

Northrop Aircraft, a non-union firm, granted its employes wage raises which kept the company in line.

Rohr aircraft employes, represented by IAM, were to vote yesterday on whether or not to authorize a strike. Negotiations were continuing, however.

Rheem Manufacturing's Aircraft Division employes balloted late last week on whether or not to accept a company proposal patterned on the Lockheed settlement.

Negotiations were continuing at Boeing Airplane Co. in Seattle.

News Digest

Fairchild F.27 number one prototype suffered some damage to aft fuselage when plane's main landing gear retracted while it was parked on the ramp. Mishap is attributed to failure to engage gear downlocks, was not due to a mechanical malfunction. Test program is being transferred to number two prototype, expected to start flying last week.

Preliminary negotiations for purchase of Westrex Corp., wholly-owned subsidiary of Western Electric Co., by Litton Industries, Inc., have been completed. Westrex distributes and services a line of communications products, including teletype, and equipment for motion picture industry. Gross income in 1957 was more than $13 million.

American Airlines earned $2,909,000 during the first four months of 1958, a drop from the $2,991,000 earnings of the comparable 1957 period, the airline announced last week. President C. R. Smith told a stockholders' meeting that traffic has not shown the growth of recent years and attributed this fact chiefly to the economic recession.

Re-Entry May Balk Manned Red Satellite

New York—Reason the Russians didn't place a man in their third earth satellite was probably because they hadn't yet been able to lick the re-entry problem, Brig. Gen. Donald Flickinger, director of life sciences, USAF, said at a meeting of the Wings Club here.

A 3,000-lb. satellite would be big enough to put a man in orbit, he said; in fact, Gen. Flickinger does not believe that it would take this much to do the job. "Since," he said, "there is no equivalent of AVIATION WEEK in Russia, we don't know why they didn't, but we do know of a number of particular problems that could be the reason."

Among the obstacles to manned space flight, apparently still unsolved by either Russia or the United States, Gen. Flickinger mentioned the following:

• **Re-entry** problem still has to be licked. If he had to guess just which problem it was that prevented the Russians from putting man inside their third satellite, Gen. Flickinger said this would be it.

When the space capsule hits the sensible atmosphere, it will run into the combined problem of high deceleration forces and heat of re-entry. The pure ballistic approach to re-entry, which requires no pilot control, will probably be the quickest method attainable. But present ballistic re-entry vehicles destined for the Jupiter, Atlas, and Titan, will not be adequate for manned re-entry Gen. Flickinger feels—not, he says, as much because of the heating problem as because of the difficulty of controlling the re-entry angle to prevent build up of high G Loads.

• **Reliability** of the system itself is still too low.

• **Means of escape** for the human passenger while he is still on the launch pad. Many missile accidents occur during the first 10% of the missile launch phase, he reminded his listeners.

• **Escape mechanism** that will automatically eject the passenger in case of trouble during the boost phase. After the boost phase, the mechanism must also lock out to prevent any possibility of the passenger himself being thrown into orbit.

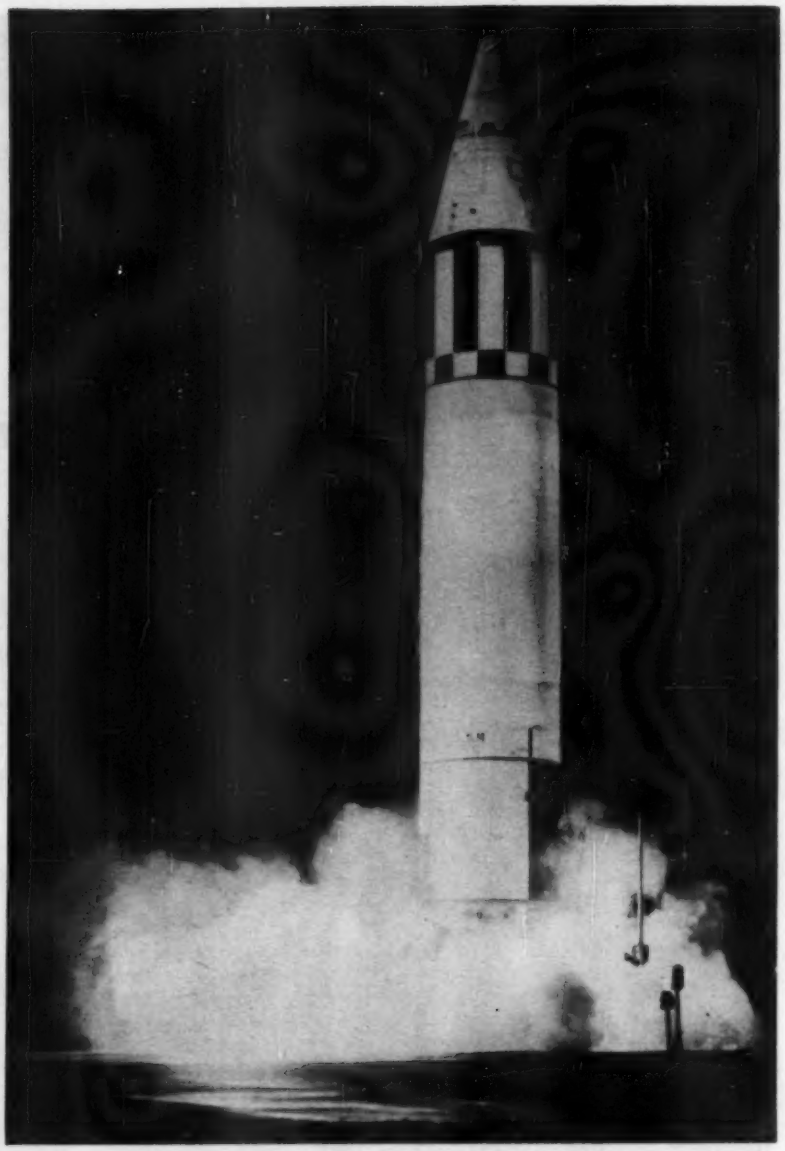
• **Problems still associated** with providing a livable environment and with determining the effects of weightlessness.

Gen. Flickinger gave as an example regenerative systems with algae and the like which work fine in the laboratory, but which won't work at present in an actual space capsule. A complete replenishment system will be needed. This will be correspondingly heavier and the amount of weight that can be put in the space capsule with the occupant is critical.

More precise trajectory control is needed to insure a modest circular orbit, preferably one ranging in altitude no more than from 100 to 300 mi. Among other things, this will permit re-entry with a minimum weight of retro-rockets.

Tracking of and communication with the space capsule will be essential and still pose a considerable problem.

Similarly, terminal recovery techniques must be improved. Total re-entry path will probably run 7,000 to 10,000 mi. and it will be difficult to predict where the capsule will land. At the same time, it is essential that the occupant be found immediately.



Army Claims Re-Entry Success

Army says first full-scale IRBM nose cone re-entered the atmosphere and was recovered intact after the latest firing of the Jupiter missile from the USAF Missile Test Center, Cape Canaveral, Fla. The nose cone traveled 1,600 mi. down range and landed in its "prescribed" impact area. Recovery of the nose cone was effected through a Cook Research Laboratories system which slowed its descent into the ocean with a parachute and then kept it afloat with a balloon until the search party homed on a radio beacon and found the nose cone. The system also dropped a small explosive charge at the impact point. The charge exploded at a great depth, and its signal was picked up at three sonar stations. The nose cone position was determined by triangulation. This system which was used by the Coast Guard in 1937 has since been classified.

Airlines Split on No-Show Control Plan

American battles to have no-show plan dropped; Eastern, National, Northeast ask for continuance.

By L. L. Doty

Washington—Airline industry is split over the effectiveness and need for a no-show control plan, with American Airlines leading the opposition to the program.

In a compromise move following American's opposition to the plan, the industry earlier this month voted at an Air Traffic Conference meeting to discontinue the $3 no-show penalty plan Aug. 12 (AW May 19, p. 40).

Minimum time limit (MTL) on ticket pickup and the reconfirmation rules were extended to Dec. 1. However, each of these phases of the three-way plan are likely to be watered down in the face of American opposition when the Air Traffic Conference meets in November to consider the no-show problem further.

Among the local service airlines, Mohawk opposed even the compromise plan because, it said, the plan caused "extreme inconvenience and expense to the traveling public and the airline." As a result, Mohawk will be exempt from all provisions of the plan on Aug. 12. Allegheny also will be exempt from the plan on the Detroit-Erie route where it is competitive with Mohawk.

Sharp Split

Final result of the bitter disagreement on the issue will be an even sharper split within the industry with Eastern, National and Northeast joining forces to continue the plan on the New York-Florida route after other carriers have dropped it. Possibility that the latest action may prompt the Civil Aeronautics Board to implement a less flexible ruling than the present plan is also of deep concern to more than one carrier.

The latest Air Traffic Conference meeting, at which the compromise plan was accepted, was, in effect, an extension of the April meeting when American startled ATC members by openly declaring its opposition to the plan. It was a complete reversal of position for American which was the original proponent of the plan and devoted much time and energy in initially selling the idea to other carriers.

Following American's announcement at the April meeting, the conference agreed to recess until the May session to give each carrier time to analyze, study and review the plan's effectiveness. Eastern, an outspoken champion of the existing plan, offered a detailed exhibit to the May meeting in support of the plan. The airline has charged that no other carrier, including American, bothered to prepare a thorough analytical presentation either for or against the plan.

American Airlines was prepared to adopt its own no-show plan in the event the industry voted to retain the present plan. Because the compromise plan was adopted by the conference after two days of argument, American decided to drop its own plan and accept the compromise program at least until the November Air Traffic Conference meeting.

American Plan

The American plan illustrates the carrier's chief objections to the existing program and spells out its basic philosophy for the handling of the no-show problem.

Essentially, American's plan would eliminate the penalty clause and place the burden of double-checking reservations on the airline rather than on the passenger.

Furthermore, American would modify the minimum time limit on ticket pickups to exclude travelers located in outlying areas or ones who would be asked to purchase tickets at inconvenient hours. Above all, the airline decided that its no-show control plan would be confined to only those flights that are normally booked heavily.

American admits the present plan had merits at the time it was introduced during a period when load factors were extremely high. The plan was effective, according to the airline, in protecting seats for passengers who needed them when space was frequently tight.

However, since September, when the third phase or penalty provision of the plan was introduced, load factors have dropped substantially while available seat-miles have continued to climb. As a result, the industry is not faced with the serious seat shortage that existed up to mid-1957.

Eastern agreed that, if any adjustment to the program were to be made, the penalty plan could be discontinued since this phase, it said, has contributed to almost 50% of the cost of the entire plan.

Eastern opposed the penalty system at the spring-1957 Air Traffic Conference but supported minimum time limit and reconfirmation. Nevertheless, Eastern and the industry later compromised on the three-way program and the penalty clause was adopted.

Significant Factor

Most carriers agree that American's strong "public" stand on the issue was a significant factor in the final adoption of the over-all program. Majority of carriers originally supported both MLT and reconfirmation but MLT coupled with the penalty drew the support of but a minority few.

First penalty system was implemented in 1946 but failed because of noncompliance by a number of airlines. A penalty on coach travel was adopted in 1954 but survived for only a few months, again because of noncompliance.

American said its decision to oppose the over-all plan was based on the belief that the inconvenience caused to travelers by the plan did not justify the slight gains in revenue. The carrier said that some airlines had produced figures which demonstrated the plan was helping to recapture revenues but added that its own figures indicated the increase was not substantial enough to support continuance of the plan.

In its study, Eastern said that it recorded a drop in the number of no-shows from 110 no-shows per 1,000 passengers in March, 1957, to 56.3 in March of this year. It termed the 18 and 19 complaints per 100,000 passengers received during February and March respectively "infinitesimally small." Bulk of complaints were from passengers on whom the penalty had been imposed, the airline said.

Eastern also reported a 3.8% decrease in the average length of reservations' telephone calls since the plan was adopted as evidence that it was not bogging down reservations procedures. It added that it was unnecessary to increase personnel at ticket counters in order to handle the three-phase program.

Lost seats because of no-show dropped 54.1% from March, 1956, to March of this year, the airline said. Eastern added it had made a detailed cost analysis of the plan which showed that projected costs for 1958 would be $94,020 versus a $3,313,944 increase

in revenues as a result of the plan, a net gain for 1958 of $3,219,924.

Latest Air Transport Assn. statistics on no-shows show that since the first phase of the plan was introduced in September, 1956, no-shows were reduced by 61% as of April, 1958, in all classes of travel, including local passengers and on-line and interline connecting travelers.

In samplings taken by the ATA, 22% of late cancellations were resold by the airlines in January and 30% were resold in April.

House Votes Funds For Traffic Control

Washington—Positive congressional action to meet the mounting problem of air traffic control was highlighted last week by House passage of Fiscal 1959 budgets for the Civil Aeronautics Administration, Civil Aeronautics Board and the Airways Modernization Board. The bill is now before a Senate appropriations subcommittee.

The House vote amounted to an across-the-board approval of the three agency budgets based on a premise of increased facilities for air safety. In supporting the requests, the committee said it "recognizes the urgent need for improved control of air traffic, both on and off the airways. Facilities must be adequately manned and maintained if we are to move forward with a program which will insure the safety of every pilot and air traveler.

"The increasing speed and activity of military jet aircraft, as well as the advent of the jet age in commercial air transportation, present a challenge which the Congress has met and will continue to meet squarely."

CAA was recommended for a budget of $421,950,000, a reduction of $16,750,000 from its original request. The committee proposed that $16.5 million of this decrease be acquired by transfer from Department of Defense funds in conjunction with an established joint use policy on Vortac installations with the military.

Concern was expressed over CAA's present limitation of only five super grade positions, which the committee recommended be increased to 10 in keeping with a staff that will reach nearly 30,000 by 1959.

Committee members also recommended 10 super grade positions for the CAB in a total budget approval of $46,750,000, of which $40.7 million reflects increased subsidy payments to air carriers. The balance shows $510,000 for salaries and expenses over current appropriations. The committee said the Board should accelerate its study of air space control as a framework for CAA enforcement.

AMB was recommended for a budget of $30 million, a reduction of $4.3 million from its request. The committee said the budget was cut because AMB's present rate of obligation would have to be doubled to meet the original budget requests. The recommended amount, it said, should allow AMB to build up its research and development program for new systems for air traffic control and allows for an increase of 243 staff positions over that of Fiscal 1958.

MATS Defends Transport Role

By Robert H. Cook

Washington—Military spokesmen say "unfair competition" charges leveled at the Military Air Transport Service by the airlines pose a dangerous threat to MATS' role as a combat ready supporting force in the event of war.

The MATS spokesmen took a firm stand on this point in testimony before a special Senate subcommittee investigating charges that the military service has failed to comply with a congressional directive to award 40% of its passenger and 20% of the cargo contracts to commercial airlines. Both scheduled and nonscheduled carriers have charged that MATS competition is a primary reason behind falling revenues on overseas passenger and cargo operations.

Four certificated all-cargo carriers recently filed for subsidy largely on the basis of this claim.

In both the Senate hearing and recently-completed testimony before a House appropriations committee, MATS has emphasized the importance of the size of its fleet, 1,500 aircraft—the achievement of a higher fleet utilization rate and the necessity for intensified training.

Details of MATS-planned initial combat support of the Strategic Air Command were reported to Senate and House members in closed sessions.

MATS reports that it will spend $70 million this fiscal year for commercial air transportation and expects the figure to climb to $84 million for Fiscal 1959. As evidence that it is attempting to comply with the congressional directive, the military says the Fiscal 1958 percentage breakdown on the future is 36.8 passengers and 6.3 cargo. Realization of the 40% and 20% formula requested, it said, would have increased its appropriations for Fiscal 1958 by $20.4 million.

Dudley C. Sharp, Assistant Secretary of the Air Force, told the House that projected figures for Fiscal 1959 show that $54.8 million for passengers and $30.1 million for cargo transportation by commercial carriers would be needed to fully comply with the demands of Congress.

Appearing before the Senate committee, Sharp said that, since MATS must be retained on a ready alert basis, the aircraft must be used in regular operations in order to defray part of the Department of Defense costs. He also indicated that MATS airlift operations would be accelerated in an effort to reach a six-hour utilization rate as opposed to the present rate of four hours.

Any action to reduce this rate would constitute a "serious gamble" with MATS wartime mission, he said.

Sharp also took issue with the commercial carriers who depend heavily upon military business which, he said, "fluctuates and is an undependable source of revenue."

Commenting on the sale of flight equipment by carriers who charge that MATS is driving them out of business, Sharp said it is not an Air Force responsibility that "they bought too many planes." MATS, he added, must use its full capabilities and is not responsible "for subsidizing carriers."

Lt. Gen. William H. Tunner, for the past four years Air Force Chief of Staff in Europe, testified in his new role as MATS commander. Gen. Tunner was in charge of the Berlin and Korean airlifts as well as the "Hump Operation" during World War II.

Size of the MATS fleet has been determined by the Joint Chiefs of Staff as the minimum number of planes needed for the initial phase of an emergency. He said that MATS at its present strength can meet this initial need and would be supported within 48 hours by the Civil Reserve Air Fleet of 362 four-engine aircraft.

MATS has ordered 50 Douglas C-133 carriers to handle heavy equipment.

Secretary Sharp, in reply to an inquiry by Sen. Mike Monroney (D.-Okla.), told the Senators that the Air Force expended between $70 million and $90 million on the larger Douglas 132 but canceled a planned order for 30 when the sale price came to a total of more than $600 million. Explaining that the money was needed elsewhere, he added that the aircraft had such a large capacity that MATS would probably have not needed 30.

Committee members also questioned a proposed expenditure of $15 million for the purchase of three Boeing 707 jets which Sharp explained were needed "in the cold war" with the Soviets who fly their top officials in jet airliners. The United States could not afford to suffer in comparison, a philosophy endorsed by the State Department, said the Secretary.

Third CAA Airway Plan Includes Automatic Control Provisions

Washington—Civil Aeronautics Administration last week issued a third federal airway plan that includes provisions for the first elements of automation of air traffic control.

As in the case of the first two plans, emphasis is placed on radar control to handle traffic in multiple terminal areas and on high density routes. The report also points up the importance of radar control in the integration of piston engine and turbine powered aircraft.

First federal airway plan, covering fiscal years 1957-1961, was established on grounds that modernization of the airways would require a total of five years.

The second plan telescoped the original program into three years and funds for Fiscal 1958 were appropriated for that purpose.

The new plan, covering the years 1959-1963, revises the previous plan "to reflect present conditions, including current budgetary limitations."

Programmed Steps

Here are the steps now programmed by the CAA in its latest plan to increase traffic capacity of the airways:

- **Rapid discontinuance of LF/MF/** facilities for IFR use is proposed. CAA termed these facilities the most serious problem facing the air traffic controller today and added that elimination of the system will expand available air space and eliminate numerous traffic conflicts.
- **Revise Victor airway structure** to permit greater use of express airways.
- **Stratification of airspace** to segregate long-haul and short-haul traffic and to provide for high-speed, high-altitude operations.
- **Installation of additional Vortac** facilities in major terminal areas to provide lateral separation of ingress and egress routes.
- **Installation of additional Vortac** facilities on high-density routes to provide multiple express airways, laterally separated.
- **Additional flexibility in the selection** of radio fixes, especially through the use of distance (rho) measuring facilities.

The plan calls for increased reliance on radar during the next five years in the use of new types of air traffic control displays. Flight progress boards at many air route traffic control centers will be supplemented by radar displays with a strong possibility that projection techniques will be used.

CAA began the establishment of automatic data-processing and transfer equipment in Fiscal 1958. It admitted that, under the third plan, some aspects of the over-all program leading to automation may not be carried out until the latters years of the plan because of the need for more extensive development and evaluation work.

Flight Distances

In its study of current air traffic conditions as a basis for the plan, the CAA emphasized that air traffic "was, is and will be" a short-haul business. It said that surveys of en route IFR traffic show that nearly one of every four IFR flights has a distance of less than 100 mi.

The report said 50% of such flights covered distances of less than 200 mi. and added that the pattern during the 1959-1963 period is expected to remain about the same.

The report said that the 16.2 million itinerant aircraft operations recorded during Fiscal 1957 at airports with CAA traffic control service were 5.6 million greater than the count in Fiscal 1953 for an increase of 53.7%. CAA forecast 22 million itinerant aircraft operations in 1960 and 30 million in 1965.

The report said total intercity travel has grown more rapidly than both population and the gross national product but added that such growth has been limited to the private automobile and the airlines. It said that, despite the amazing increase of airline passenger traffic, "there is still plenty of room for growth; in 1956, air was only 3.3% of the total intercity and 35.9 of the common carrier intercity travel market."

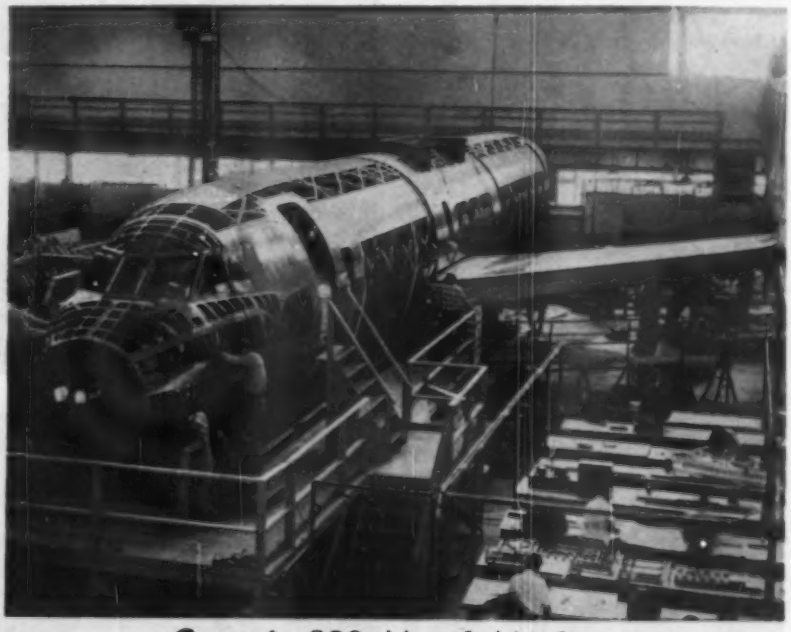
CAB Lawyers Term Air Contest 'Unfair'

Washington—The Civil Aeronautics Board's Office of Compliance has requested the Board to order National Airlines to halt a $75,000 sales promotion contest which is now under way.

The airline is offering 200 prizes to passengers who fly its routes between April 1 and June 30. Entry blanks stipulate that the contest is "subject to all federal, state and local laws, regulations and orders."

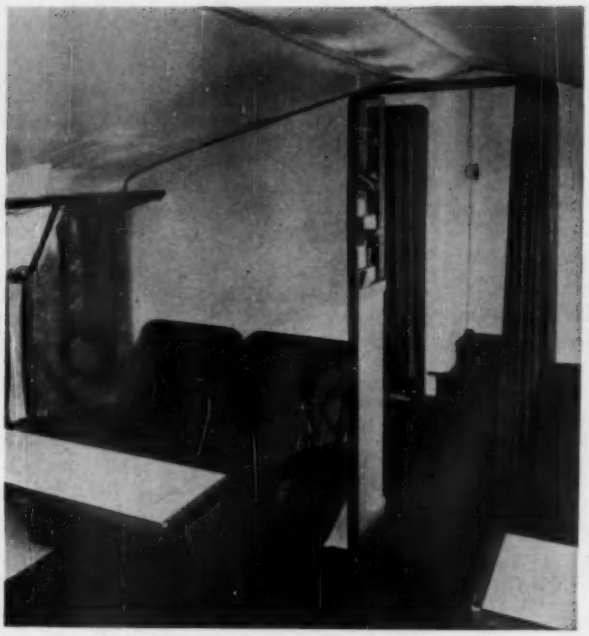
Compliance attorneys contend that the contest constitutes an "unfair method of competition," violating provisions of both Sections 403B and 411 of the Civil Aeronautics Act.

Awarding of prizes, they say, could be a rebate on part or all of the cost of the prize winner's tickets.



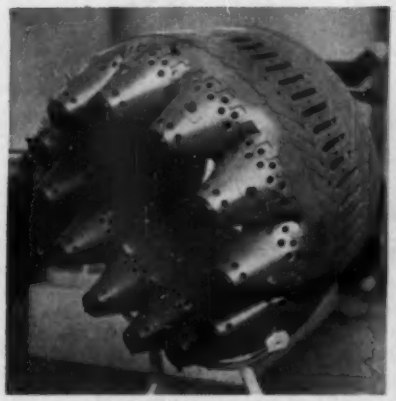
Convair 880 Metal Mockup

All-metal mockup of Convair 880 jet transport nearing completion at San Diego, Calif., will be structurally accurate replica of entire fuselage and one wing of the airplane. Mockup also will include full detail on flight deck. Much of skin area is left open to provide easy access in placement of electrical wiring, tubing cables and other equipment. Mockup allows engineers to work out exact placements so installations can be made on-station from start of production, instead of after roll-out. Swept-wing jet transport is scheduled to go into airline service early in 1960.



Mockup Shows Interior of East German BB-152

Mockup of East Germany's BB-152 jet transport shows that aircraft, designed by Prof. Brunolf Baade, will have Viscount-type windows that can be used as emergency exits. Interior will be decorated in shades of blue, from light to dark, with contrasting brown. Overhead racks do not combine services such as lights, call buttons. Type 014 turbine engine and components (below) were displayed in technical section of Leipzig fair. Annular combustion chamber (left) shows good quality of workmanship on spot-welded structure. Two-stage turbine (at left in right photo) has bearings just ahead of the turbine and at the near end of the shaft. Annular combustion chamber is in center of right photo; complete engine is on display behind it. Transport was rolled out recently (AW May 12, p. 41).



Annular combustion chamber of 014 turbine engine is ceramic-coated (left). Complete engine with components is displayed at right.

Airlines List Executive Pay, Bonuses

Washington—Following is a list of airline executive and director salaries, bonuses and indirect compensation; expenses and stock holdings as reported by the airlines to the Civil Aeronautics Board.

Domestic Trunk Airlines

EASTERN AIRLINES INC.—E. V. Rickenbacker, general manager and chairman, board of directors, $50,000 salary, $900 bonus and indirect compensation and 106,173 shares of common stock; **T. F. Armstrong**, president and director, $35,000 salary, $900 bonus and indirect compensation, 2,609 common shares directly owned and 1,040 common shares of stock in the name of others; **P. H. Brattain**, first vice president and director (retired 6/1/57), $15,416.60 salary, 7,600 bonus and indirect compensation and 19,768 shares of common stock; **S. L. Shannon**, senior vice president and director, $30,000 salary, $900 bonus and indirect compensation and 11,445 shares of common stock; **G. A. Smith**, second vice president, $20,000 salary, no bonus and 416 shares of common stock; **T. E. Creighton**, treasurer and director, $17,500 salary, $900 bonus and indirect compensation and 1,040 shares of common stock.

L. P. Arnold, vice president, $22,500 salary, no bonus and 4,578 shares of common stock; **M. M. Frost**, vice president, $27,500 salary, no bonus and 1,873 shares of common stock; **W. L. Morrisette**, vice president, $17,500 salary, no bonus and 208 shares of common stock; **W. Van Dusen**, vice president, $21,666.56 salary, no bonus and 2,650 shares of common stock; **C. Froesch**, vice president, $17,500 salary, no bonus and 1,872 shares of common stock; **B. T. Dykes**, vice president, $29,600 salary, no bonus and 674 shares of common stock; **G. W. Channell**, assistant vice president, $10,500 salary, no bonus and 140 shares of common stock; **J. H. Brock**, vice president, $20,000 salary, no bonus and 1,148 shares of common stock; **R. Ramspeck**, vice president, $20,000 salary, no bonus and 660 shares of common stock; **J. K. Kilcarr**, assistant treasurer (resigned 1/31/57), $1,000 salary, no bonus and stock holdings not available.

C. J. Simons, assistant treasurer, $7,650 salary, no bonus, 110 common shares directly held and 53 shares of common stock in name of others; **J. C. Warlick**, assistant secretary, $10,000 salary, no bonus and 294 shares of common stock; **R. S. Lipp**, secretary, $9,000, no bonus and 126 shares of common stock; **E. E. Hahn**, assistant treasurer, $8,250 salary, no bonus and 82 shares of common stock; **C. A. Wallen**, assistant treasurer, $8,250 salary, no bonus and 26 shares of common stock.

E. R. Cook, director, no salary, $200 bonus and indirect compensation, 1,356 common shares directly held and 318.24 shares of common stock in name of others; **P. M. Davis**, director, no salary, $400 bonus and indirect compensation and 2,914 shares of common stock; **G. B. Howell**, director, no salary, $600 bonus and indirect compensation and 1,561 shares of common stock; **H. Knowlton**, director, no salary, $600 bonus and indirect compensation and 104 shares of common stock in name of others; **S. Peabody Jr.**, director, no salary, $400 bonus and indirect compensation and 308 shares of common stock; **P. E. Reinhold**, director, no salary, $600 bonus and indirect compensation, 1,561 common shares held directly and 5,514 shares of common stock in name of others; **L. S. Rockefeller**, director, no salary, $800 bonus and indirect compensation, 98,940 common shares held directly and 3,612.84 shares of common stock in name of others; **McG. Smith**, director, no salary, $500 bonus and indirect compensation and 520 shares of common stock; **F. J. Turner**, director, no salary, $400 bonus and indirect compensation and 306 shares of common stock.

Harry B. Coen, consultant, $10,001.37; **Dewey, Ballentine, Bushby, Palmer & Wood**, legal services, $12,606.25; **Elwood Dunn**, consultant, $7,200; **Gambrell, Harlan, Russell, Moye & Richardson**, legal services, $203,960.01; **O. H. Lyon**, consultant, $12,000.

C. Moon, consultant, $6,458.39; **Price Waterhouse & Co.**, auditing, $26,493.64; **Cleary, Gottlieb, Friendly & Hamilton**, legal services, $5,037.13; **Research Services Inc.**, research-statistical, $5,129.35.

Local Service Airlines

MOHAWK AIRLINES INC.—R. E. Peach, president and director, $25,000 salary, 10,698 shares of capital stock and 25,000 debt securities; **J. B. Carver**, vice president and director, $20,511 salary, 4,018 shares of capital stock and 2,000 debt securities; **C. A. Bensceter**, vice president, $21,000 salary, 5,632 shares of capital stock and 5,000 debt securities; **T. J. Kirkup**, vice president, $12,000 salary, 1,000 shares of capital stock and 10,000 debt securities; **D. E. Postle**, vice president, $12,500 salary, 600 shares of capital stock and no debt securities; **E. V. Underwood**, treasurer and director, $4,028 salary, 3,000 shares of capital stock and 1,000 debt securities; **F. R. Chabot**, assistant treasurer, $10,833 salary and no capital stock or debt securities; **B. C. McLean**, secretary, $8,800 salary, no capital stock and 500 debt securities; **B. J. Miner**, director, no salary, 133 capital shares and no debt securities; **C. N. Silcox**, director, no salary, 2,000 shares of capital stock and 2,500 debt securities.

J. D. Hogue, director, no salary, 100 capital shares and no debt securities; **W. J. Fields**, director, no salary, 1,000 capital shares of stock and no debt securities; **E. A. Link**, director, no salary, 24,111 shares of capital stock and 125,000 debt securities; **P. A. Schoellkopf**, director, no salary, capital stock or debt securities; **C. F. Johnson Jr.**, director, no salary, capital stock or debt securities; **J. C. Corwith**, director, no salary, capital stock or debt securities; **R. W. Jenkins**, director of flight operations, $14,883 salary, no stock or debt securities; **Gilfoil & McNeal**, public accounting, S. E. C. registration and systems study, $9,441; **S. S. Colker Associates**, preparation of exhibits for route cases, $5,194; **Pogue & Neal**, general legal services, $14,558.

PACIFIC AIRLINES (formerly Southwest Airways)—**L. Hayward**, chairman, board of directors, no salary, $100 bonus and indirect compensation, $780 expenses and 143,988 shares of common stock; **J. H. Connelly**, president and director, $25,000.08 salary, no bonus, $4,498 expenses and 142,884½ shares of common stock; **T. R. Mitchell**, vice president and director, $18,000 salary, no bonus, $3,321 expenses and 2,000 shares of common stock; **E. R. Dahl**, treasurer, $6,288.34 salary, no bonus, $733 expenses and 200 shares of common stock; **R. E. Costello**, vice president and director, $10,600.08 salary, no bonus, $3,387 expenses and 365 shares of common stock.

M. A. King, vice president, $10,399.92 salary, no bonus, $7,500 expenses and no stock; **W. Roche**, secretary and director, no salary, $100 bonus and indirect compensation, no expenses and 716 shares of common stock; **F. Hendrickson**, assistant secretary and director, no salary, $100 bonus and indirect compensation, no expenses and 1,040 shares of common stock; **B. Allenberg**, director, no salary, $50 bonus and indirect compensation, no expenses and 5,700 shares of common stock; **D. O'Shea**, director, no salary, bonus or expenses and 1,162 shares of common stock; **W. B. Smullin**, director, no salary, $100 bonus and indirect compensation, no expenses and 100 shares of common stock; **Bradshaw, Shearin, Redding & Thomas**, legal services, $25,485; **Price Waterhouse & Co.**, auditing and accounting, $11,151; **Abbott Kimball Co.**, advertising and commissions therein, $184,484.

SOUTHERN AIRWAYS INC.—F. W. Hulse, president and director, $18,000 salary, $5,486 expenses, 36,219 common shares directly held and 2,000 shares of common stock in name of others; **C. M. Britt**, vice president-sales, $24,571 salary, $3,563 expenses, 3,200 common shares directly held and 200 shares of common stock in name of others; **W. S. Magill**, vice president-operations, $14,400 salary, $1,022 expenses and 800 shares of common stock.

G. F. Estey, secretary and treasurer, $12,000 salary, $975 expenses and 1,541 shares of common stock; **C. H. D. Tarrer**, assistant treasurer, $9,150 salary, $765 expenses and 325 shares of common stock; **C. A. Beasley**, assistant secretary and director, $2,400 salary, $200 expenses and 3,500 shares of common stock; **I. F. Jones**, vice president and director, no salary, $144 expenses and 2,167 shares of common stock; **W. B. White, Jr.**, assistant secretary and director, no salary, $150 expenses and 220 shares of common stock.

I. Allen Jr., director, no salary, $112 expenses, 2,766 2/3 common shares and 1,542 common shares of stock in name of others; **J. M. Atkins**, director, no salary, $100 expenses and 220 shares of common stock; **A. J. Brunini**, director, no salary, $151 expenses and 2,000 shares of common stock; **E. U. Benche**, director, no salary, no expenses and 1,000 shares of common stock in name of others; **H. P. Johnston**, director, no salary, $150 expenses and 2,500 shares of common stock; **G. G. Jordan**, director, no salary, $100 expenses and 1,666 2/3 shares of common stock; **W. H. Smith**, director, no salary, $166 expenses and 500 shares of common stock; **E. B. Stephens**, director, no salary, $160 expenses and 1,495 shares of common stock; **Gen. R. H. Wooten**, director, no salary, $215 expenses and 5,500 shares of common stock; **A. F. Irby**, director, no salary, $50 expenses and 1,600 shares of common stock.

R. E. Orr, director, no salary, $277 expenses and 1,000 shares of common stock in name of others; **Henry Beecken & Associates**, airline consultant, $9,189; **Kilpatrick, Ballard & Beasley**, legal services, $19,709.

Territorial Airlines

HAWAIIAN AIRLINES LTD.—A. D. Lewis, president and director, $40,240 salary, $6,094 expenses and 500 shares of common stock; **B. Cooke**, vice president and treasurer, $22,000 salary, $3,150 expenses and 50 shares of common stock; **L. D. Machado**, vice president—operations, $20,500 salary, $4,994 expenses and 235 shares of common stock; **J. C. Tobin**, vice president—sales, $20,500 salary, $5,434 expenses and 125 shares of common stock; **L. P. Irons**, secretary, $10,340 salary, $435 expenses and 100 shares of common stock; **G. K. Tanabe**, assistant treasurer and assistant secretary, $10,600 salary, $681 expenses and 150 shares of common stock; **S. C. Kennedy**, chairman, board of directors, $220 directors fee, no expenses and 22,473 shares of common stock; **R. J. Behnke**, director, no salary, expenses or stock; **J. M. Greenwell**, director, $470 director fee, no expenses and 2,000 shares of common stock; **M. B. Carson**, director, $220 director fee, no expenses and 7,692 shares of common stock.

Chinn Ho, director, $160 director fee, no expenses and 5,038 shares of common stock; **A. D. Lewis**, director, $220 director fee, no expenses and 2,213 shares of common stock; **J. E. Russell**, director, $140 director fee, no expenses and no stock; **Sakae Takahashi**, director, $140 director fee, no expenses and 550 shares of common stock; **W. Tsukiyama**, director, $240 director fee, no expenses and 50 shares of common stock; **G. Vicars**, director, $220 director fee, no expenses or stock; **D. Watson**, director, $240 director fee, no expenses and 1,650 shares of com-

mon stock; **H. W. B. White**, director, $430 director fee, no expenses or stock; **G. P. Wilcox**, director, $160 director fee, no expenses and 3,049 shares of common stock; **T. Smythe**, director, $40 director fee, no expenses or stock.

TRANS PACIFIC AIRLINES LTD. (Aloha Airlines)—**R. F. Tongg**, president and director, $13,800 salary, $100 bonus and indirect compensation and 64,600 shares of common stock; **D. A. Bens**, executive vice president and director, $12,800 salary, $100 bonus and indirect compensation and 10,000 shares of common stock; **H. K. Hee**, vice president and director, $7,800 salary, $100 bonus and indirect compensation and 10,000 shares of common stock; **J. Y. Ing**, vice president and director, $7,200 salary, $100 bonus and indirect compensation and 43,000 shares of common stock.

W. E. Wood, vice president and director, $3,231 salary, no bonus or stock; **A. K. Wong**, secretary and director, $3,600 salary, $100 bonus and indirect compensation and 4,000 shares of common stock; **C. D. Young**, treasurer, $11,425 salary, $100 bonus and indirect compensation and 4,660 shares of common stock; **H. A. Bowen**, assistant secretary, no salary, $6,000 bonus and indirect compensation and no stock; **D. K. Ainoa**, vice president and director, no salary, $75 bonus and indirect compensation and 4,350 shares of common stock; **Hunt Wei Ching**, vice president and director, no salary, $75 bonus and indirect compensation and 11,000 shares of common stock; **Sai Chow Doo**, vice president and director, no salary, $4,275 bonus and indirect compensation and 15,300 shares of common stock; **Y. Baron Goto**, vice president and director, no salary, $75 bonus and indirect compensation and 2,000 shares of common stock.

Katsumi Kometani, vice president and director, no salary, $50 bonus and indirect compensation and 5,000 shares of common stock; **E. L. Lau**, vice president and director, no salary, $100 bonus and indirect compensation and 750 shares of common stock; **A. Paul Lam**, vice president and director, no salary or bonus and 24,800 shares of common stock; **R. C. Tongg**, vice president and director, no salary, $25 bonus and indirect compensation and 10,000 shares of common stock; **C. Boettcher**, director, no salary, $25 bonus and indirect compensation and 5,000 shares of common stock; **Ken Yen Chan**, director, no salary, $100 bonus and indirect compensation and 3,000 shares of common stock.

New Runway Needs Outlined by Pyle

San Juan, Puerto Rico—Civil Aeronautics Administrator James T. Pyle told the Airport Operators Council at its annual meeting here that an "across-the-board" revision of runway lengths will be necessary at airports planning to accommodate jet transports.

Pyle warned that the turbine-powered transports will require stronger and longer runways with high-speed turnoffs and that taxiway shoulders must be paved and kept free of foreign objects. He said manufacturers have a basic responsibility in airport planning for jet operations and added:

"The manufacturers should not design and build aircraft without regard for the limitations of the airport facilities available."

Stuart G. Tipton, president of the Air Transport Assn., told the conference that one of the most serious problems of airport operators is competing with other services such as schools and streets for the taxpayer's dollar. He said it is a "joint responsibility" of the carriers and airport operators to make people aware that an airport is a community asset and promised that the ATA would make a "public relations survey of most of the major airports in the nation" toward this end.

E. R. Quesada, chairman of the Airways Modernization Board, said 18 projects covering airport research and development are in the AMB plan to modernize aviation facilities. He named runway visual aids, separation and configuration of runways, and removal of snow, ice and debris as among the projects.

Quesada said his group is seeking patterns of runway marking and lighting that furnish the pilot the easiest change-over "to the real world after his eyes leave the cockpit instruments."

He disclosed that AMB plans to obtain a new simulator that gives a realistic presentation of runway visual aids in the various technical areas now under study by the group. The device will consist of a television camera that picks up patterns constructed on a moving belt.

By use of filters simulating different speeds, the AMB hopes to collect human-reaction data from the TV system hooked to a training simulator.

AMB also plans, Quesada said, a comprehensive flight-test program covering checks of visual aids installed at Sisterberg, Copenhagen, Gatwick, Skipol, Dow Air Force Base and Washington National Airports.

Seaboard Asks CAB To Approve Purchase

New York—Seaboard and Western Airlines is seeking Civil Aeronautics Board approval to purchase a 25% minority interest of 500,000 shares in Irish Airlines (Aerlinte Eireann).

Seaboard's application said the airline would pay $2.80 a share or $1.4 million for the stock. The purchase would also give Seaboard minority representation on the Irish airline board of directors.

Irish Airlines has an authorized capitalization of 5,000,000 shares of which 1,425,000 are issued.

These are owned by Aer Rianta Teoranta, a corporation owned by the Irish Government. Seaboard's purchase would bring the total stock issued to 1,925,000.

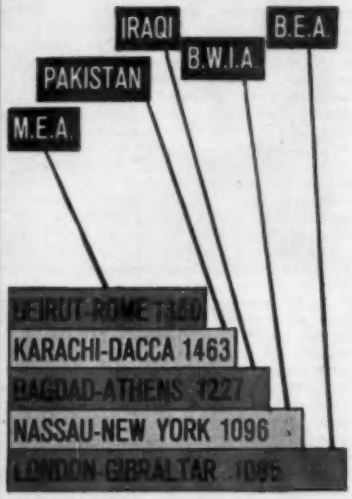
Irish Airlines began transatlantic service last month (AW May 12, p. 42).

Charter restrictions originally proposed in the CAB exemption permitting Irish Airlines to operate Lockheed 1049H Super Constellations leased from Seaboard into the U.S. have been dropped.

THE RECORD-BREAKING
VISCOUNT

FLIGHTS OVER 1000 MILES

Both from the standpoint of operating economy and fast scheduling, the Viscount has proved itself the ideal aircraft for 1000-plus-mile routes as well as for considerably shorter ones. Here are a few examples of regular long-distance Viscount "700" flights:

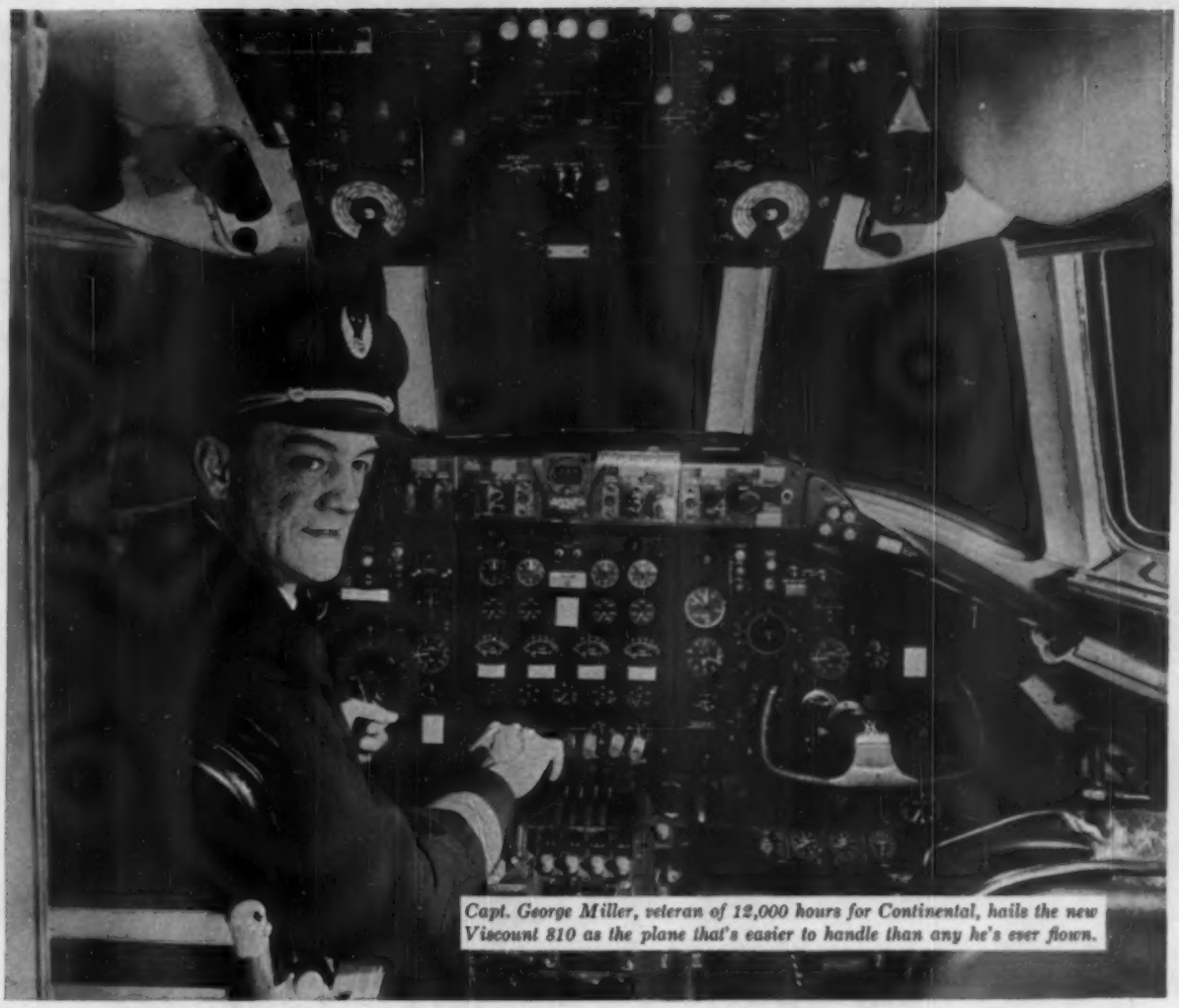


NEW SPEED RECORDS SET

Middle East Airlines' Viscounts recently broke *two more* speed records. One of their Viscounts flew from Zurich to Athens in 3 hours, 7 minutes, averaging 344 mph. Another made the Vienna to Istanbul hop in just 2 hours, 50 minutes, flying at an average of 365 mph. These newest speed records are in addition to four others previously set by MEA Viscounts.

SAFARI, ANYONE?

Two new Viscount 810's are soon to go on safari in Africa! Airwork Ltd. has ordered the jet-prop planes for ferrying hunting parties deep into the domain of the rhino and the wildebeest. It seems that no place on earth presents operating conditions too difficult for the dauntless Viscount!



Capt. George Miller, veteran of 12,000 hours for Continental, hails the new Viscount 810 as the plane that's easier to handle than any he's ever flown.

FAST, SMOOTH, EASY TO HANDLE... CONTINENTAL'S NEW VISCOUNTS

"This new Viscount 810 handles like a dream", says Capt. George Miller, Chief Pilot for Continental Air Lines. "The Rolls-Royce Dart 525 jet-props are started by a fully automatic, timed cycle, simply by pushing a button and opening the fuel cock. These powerful engines require no warm-up or ground check. They can be opened up as soon as the ship is ready on the runway. Acceleration is smooth and fast. Control response is crisp. Take-off and climb performance are outstanding. The Viscount behaves beautifully at any altitude—and can be taken up to 30,000'. Stability is remarkable—even in turbulence.

"You can tell that pilots had a lot to do with the layout of this cockpit. It's been detail-designed with comfort and efficiency in mind. Window area is large, visibility excellent. Instruments and controls are grouped logically. The adjustable seats are especially comfortable. It all adds up to more enjoyable flying. This new jet-prop Viscount 810 is the best thing that's happened to pilots—and passengers—in many a year."

FROM THE WORLD LEADER IN JET-PROP AIRCRAFT...

VICKERS VISCOUNT 810/840

POWERED BY FOUR ROLLS-ROYCE DART ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LTD. • WEYBRIDGE, ENGLAND • MEMBER COMPANY OF THE VICKERS GROUP

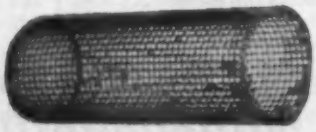
PLANE FAX

by STANDARD OIL COMPANY OF CALIFORNIA

1134 hours between majors—no repairs!

in photo and rescue work where dependable power is a must

"To be successful in our business — which includes low-altitude photo flights and aerial rescue work — you need two basic requirements: a good airplane and dependable fuels and lubricants," says Al Hudgin of Hudgin Air Service, Tucson, Arizona. "That's why we use Chevron Aviation Gasoline and RPM Aviation Oil Compounded in all our planes. Here's just one example of what I mean: We get exceptional service from a Lycoming 150 h.p. engine in our Piper-Tri Pacer. This engine gave top performance for 1134 hours between overhauls! On inspection, pistons showed no lacquer or varnish. Rings were completely free and clean. All oil screens were clear, too, and free of any deposits...engine condition was such that I feel it could have flown another several hundred hours." Al Hudgin sums up his satisfaction this way: "We're sold all over again on Chevron and RPM Aviation Products every time we service our engines. Their top condition gives us a wide safety margin against breakdown . . . for safer, more economical and dependable flying. That's what keeps us in business."



Typical piston and oil screen after 1134 flying hours on RPM Aviation Oil Compounded.

We take better care of your plane

CHEVRON AVIATION GASOLINE

AVIATION OILS RPM

T.M.'S "RPM," "CHEVRON," "PLANE FAX," REG. U.S. PAT. OFF.

SHORTLINES

▶ **Pan American World Airways** reports that gross operating revenues for the first three months of 1958 were $64,308,000 as compared with $66,786,000 for the same period of last year. Passenger revenues were down 3% to $47,788,000 and freight revenues down less than 1% at $7,087,000. The airline's operating expenses increased 4% over last year's first quarter for a net loss of $3,360,000.

▶ **Royale Air Maroc,** Moroccan airline which now uses Douglas DC-3 and DC-4 aircraft, has ordered two Sud Aviation Caravelle turbojet transports and expects to begin jet service in the summer of 1959. Royale Air Maroc is owned by Air France, the Moroccan government and the Paquet and Fraissinet shipping group.

▶ **Trans World Airlines** has completed filming the airports and adjacent areas at Nashville, Atlanta, Tampa, St. Petersburg and Miami for training purposes. The 16 mm. movies are to be used in TWA's Flight Training Center at Kansas City to familiarize and qualify pilots flying the airline's new St. Louis-Miami route. A camera was suspended from a bar across the top of the cockpit of a TWA plane and reproduced a field of vision as would be seen by the pilots of the aircraft.

▶ **United Air Lines** has awarded a $975,000 contract for construction of a jet engine overhaul building at San Francisco International Airport to Haas & Haynie, of San Francisco. The new building will be 300 ft. x 400 ft. and 26 ft. high and is scheduled for completion in May, 1959. George H. Miehls of Albert Kahn Associates is the architect. United has signed interline traffic agreements with four air carriers operating in Mexico, South America and Europe. Each interline pact provides for transportation of passengers and cargo over United's routes and of the other carrier by using a single ticket or air waybill. Addition of the four carriers, Aerolineas Mexicanas, Rutas Aereas de Colombia, Irish Airlines and Jersey Airlines, brings to 158 the number of such airline agreements involving United.

▶ **Seaboard & Western Airlines** has been authorized by Civil Aeronautics Board to carry U.S. mail between the U.S. and the seven European countries served by the all-cargo carrier. Seaboard & Western will be compensated on the same non-subsidy, service-rate basis as Pan American World Airways and Trans World Airlines.

AIRLINE OBSERVER

▶ "Use it or lose it" policy has been adopted by the Civil Aeronautics Board in providing local airline service for the first time across Nebraska, South Dakota and North Dakota. Under the plan, route segments and cities, many of which will receive airline service for the first time, must enplane an average of five passengers daily or lose the service. The Board will review each route after 18 months of operating experience and conduct formal proceedings to determine whether the service should be dropped if traffic is below the five passenger standard. The decision came out of the Seven States Case, the first of nine regional proceedings designed to expand local airline service to smaller communities throughout the nation.

▶ **Airline traffic is showing a substantial improvement this month after a seven-month period of disappointing results (AW May 19, p. 42). Although the upswing has been general on most major route segments, there are still certain areas—particularly in highly industrial sections—where the current economic slump continues to depress normal seasonal traffic growth.**

▶ Soviet airline Aeroflot has leveled new criticism against Russian airport personnel. The carrier claims that, although the quality of passenger services improved last year at some terminals, "it still isn't at a high level." At Barnual, Ukhta and Magadan, Aeroflot said, "airport workers show intolerable indifference toward passengers; at Irkutsk and Khabarovsk, transportation of incoming Tu-104 passengers to the city is poorly organized; at Kiev, Adler, Rostov and Baku, passengers wait a long time for porters." Even Moscow's Vnukovo Airport was criticized for baggage delays.

▶ **Capital Airlines plans to install air-ground public telephone in one of its Viscounts, following extremely favorable passenger reaction to similar unit installed in Northwest Airlines Stratocruiser. Equipment will be provided by AC Spark Plug Division of General Motors (AW Jan. 27, p. 90).**

▶ Civil Aeronautics Board's revised procedures covering accident investigations will be applied for the first time when the operational phase of public hearings on the Capital Airlines' Viscount accident at Midland, Mich., opens in Saginaw, June 3. Technical phase of the hearings will be held in Washington on July 8. Under the new procedures, parties to the investigation will be allowed to question witnesses for the first time. To determine whether area of questioning is material and relevant, a prehearing conference will be held June 2 in Saginaw at which time parties to the investigation will present material supporting their questions to the presiding officer.

▶ **American Airlines' sales officials are on the West Coast discussing joint sales promotion projects with Boeing and Lockheed sales people as part of American's campaign covering the introduction of the 707 and Electra late this year.**

▶ Continental Air Lines has been charged by a Negro pilot with violating Colorado's anti-discrimination law by refusing to hire him as a copilot trainee. Marlon D. Green told the State Anti-Discrimination Commission he was interviewed by Continental in Denver last June and was denied employment. Continental's attorneys denied the Commission's jurisdiction, challenged constitutionality of the law and denied any discrimination was involved.

▶ **Eastern Air Lines' first Lockheed Electra last week made its maiden flight in a test area over the Pacific Ocean in a one hour and 36 minute run. Eastern will take delivery of this plane in September and will operate an even dozen in scheduled service by the end of the year. Interior is styled in gold, blue and ivory white and is fitted with 66 seats and a lounge.**

▶ House Appropriations Committee has urged that legislation be passed in the current session of Congress to institute user charges on aircraft flying for "profit and pleasure" to cover costs of airway facilities. The committee also recommeded that consideration be given to placing similar fees on Defense Department flying activities.

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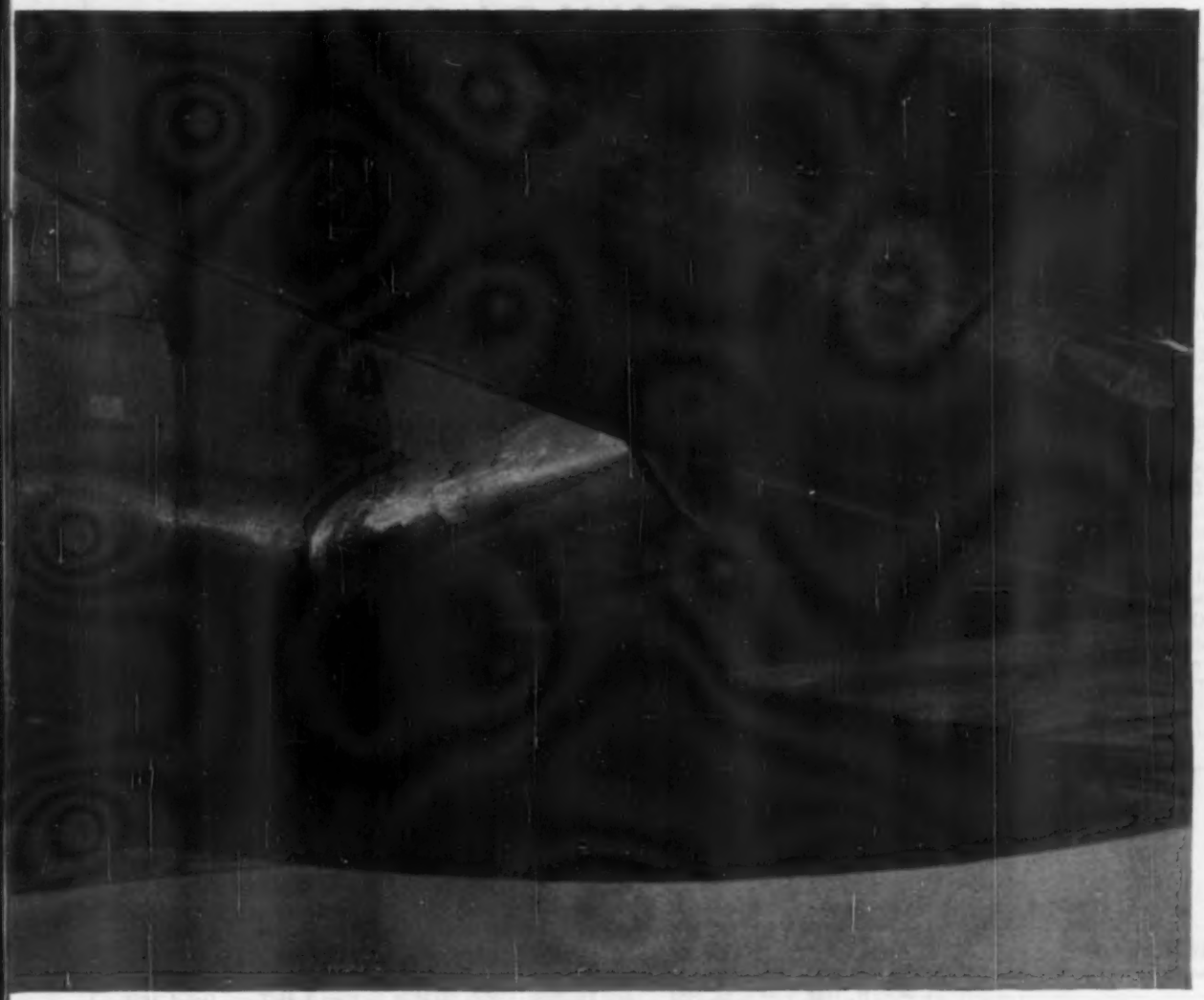

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Scientist Compares U.S.-Red Satellites

By S. B. Kramer

On Oct. 4, 1957, diligent and ever-expanding Russian science and engineering astonished the population of the western world by placing in orbit, about the earth, the first artificial satellite.

Sputnik I was the fruit of a concerted effort by Russian technical persons in what must be a vast program encompassing the military and purely scientific uses of missiles and satellites. The appearance of Sputnik II and III, and preliminary calculations on their size, strengthen the belief that at least in these aspects of engineering and science, Russia is well ahead of the United States. As is easily recognized now, the Russian successes gave some impetus to the American program so that at this writing there are three American satellites circling the earth.

The early Russian success was probably due in large part to their ability to perfect propulsion systems of substantial thrust and their prior satisfaction with unminiaturized instrumentation throughout the launching vehicles and payload. If the current thoughts on the weight of Sputnik II are reasonable, then there certainly is every reason to believe that an engine of 500,000 lb. thrust is being used in the Russian program.

A large group of parameters are common to all the satellites. Table I presents a compilation of these parameters gleaned from many published articles and unclassified sources.

Satellite Instrumentation

Instrumentation carried on the American satellites was announced in the press. Details of equipment carried on the Sputniks, although partially discussed in authoritative releases, must in general be surmised.

Vanguard I, for instance, carried aloft a transmitter, powered by mercury batteries, broadcasting continuous-wave signals on 108 megacycles. Transmission on this frequency stopped just before 8:30 p.m. EST on April 15, 1958. Vanguard I carried, as well, a solar-battery transmitter broadcasting on 108.03 megacycles; the lifetime of this unit is undetermined.

Explorer I and Explorer III are presumed to have carried similar equipment. Table II lists the detailed characteristics of the Explorer I transmitters as announced some time after launch. To this instrumentation there was added for Explorer III an omni-directional cosmic-ray counter which records into a tape recorder for 100 min. and then, upon request, reads out in six seconds the contents of the tape.

Sputnik I, according to releases at the time, carried transmitters operating at 20 megacycles and 40 megacycles, transmitting interrupted continuous-wave signals.

It is generally presumed to have recorded density and temperature measurements and broadcast them as well.

Sputnik II carried transmitters oper-

Table I—Common Parameters

PARAMETER	VANGUARD I	EXPLORER III	EXPLORER I	SPUTNIK III	SPUTNIK II	SPUTNIK I
IGY designation	1958 beta	1958 gamma	1958 alpha	1958 delta	1957 beta	1957 alpha
Launching time	7:26 A.M. E.S.T. Mar. 17, 1958	12:38 P.M. E.S.T. Mar. 26, 1958	10:55 P.M. E.S.T. Jan. 31, 1958	May 15, 1958	Nov. 3, 1957	Oct. 4, 1957
Launching place	(Cape Canaveral, Florida)			(Kapustin Yar-NW Caspian Sea Area)		
Orbital period (min.)	135	115.87	114.95	106	103.7	96
Apogee height (statute mi.)	2,513	1,741	1,575	1,170	1,025	560
Perigee height (statute mi.)	406	117	227	155	143	140
Apogee velocity (ft./sec.)	18,200	23,000	22,550	21,450	22,250	23,700
Perigee velocity (ft./sec.)	27,100	23,700	24,300	26,700	26,700	26,100
Initial orbit eccentricity	0.1951	0.1661	0.1387	.11	0.0971	0.0487
Semi-major axis (R = earth radius)	1.368R	1.2344R	1.2276R	1.167R	1.147R	1.0884R
Area-mass ratio of satellite (ft.²/lb.)	0.06875	0.06535	0.0637	.00795	.....	0.01539
Geometry of satellite	sphere d = 6.4 in.	cylinder (d = 6 in. length = 80 in.)	cylinder	cone base is 68 in. height is 11 ft. 9 in.	cone d = 59 in at base	sphere d = 22.8 in.
Fineness ratio of satellite	1	13.3	13.3	2.06	.....	1
Instrument weight on board (lb.)	3.4	20.13	18.13	2,133	1,118	184
Inclination of launch	34.5°	33.467°	34.5°	65°	65°	65°
Heading	124.5°	123.467°	124.5°	25°	25°	25°
Total weight placed on orbit (lb.)	57.1	32.4	30.8	3,550*	2,000*	330*
Weight of launching vehicle (lb.)	22,600	65,000	65,000	182,000	182,000†	182,000
Initial thrust (lb.)	27,000	83,000	83,000	264,000	264,000	264,000
Total burning time (sec.)	338	168	168	Unknown	.....	239*
Lifetime of satellite	29.6* yr.	72.4* days	1,596* days	930 days	162 days	92 days

* Estimated † Value common to current publications

Table III—Comparison of Vanguard and Sputnik

	SPUTNIK I	VANGUARD I
1. All-up weight	190,000 lb.	22,600 lb.
2. Over-all height	97 ft.	72 ft.
3. Greatest diameter	8 ft.	3.75 ft.
4. Fineness ratio	12.3:1	19:1
5. Total burning time	239 sec.	276.35 sec.
6. Total impulse	44,742,000 lb.-sec.	4,777,850 lb.-sec.
7. Useful payload	185 lb.	21.5 lb.
STAGE 1		
8. All-up weight	190,000 lb.	22,600 lb.
9. Diameter	8 ft.	3.75 ft.
10. Length	50 ft.	44 ft.
11. Mass ratio	0.71	0.664
12. Propellant weight	135,000 lb.	15,000 lb.
13. Propellant	Lox/gasoline 2.25:1	Lox/gasoline 2.25:1
14. Thrust	350,000 lb.	27,000 lb.
15. I_{sp}	252 lb.-sec./lb. at sea level	252 lb.-sec./lb. at sea level
16. Propellant consumption rate	1,390 lb./sec.	107 lb./sec.
17. Burning time	97 sec.	140 sec.
18. Burnout weight	55,000 lb.	7,600 lb.
19. Jettison	13,500 lb.	2,800 lb.
20. Velocity obtained	8,060 ft./sec. : 32.2% orbital	5,500 ft./sec. : 22% orbital
21. Height obtained	188,000 ft.	190,000 ft.
STAGE 2		
22. All-up weight	41,500 lb.	4,800 lb.
23. Diameter	5.6 ft.	32 in.
24. Length	35 ft.	31 ft.
25. Mass ratio	0.819	0.75
26. Propellant weight	34,000 lb.	3,600 lb.
27. Propellant	Lox gasoline 2.25:1	WFNA/UDMH 2.8:1
28. Thrust	83,000 lb.	7,500 lb.
29. I_{sp}	280 $\frac{\text{lb.-sec.}}{\text{lb.}}$ at alt.	270 $\frac{\text{lb.-sec.}}{\text{lb.}}$ at alt.
30. Propellant consumption rate	296 lb./sec.	27.8 lb./sec.
31. Burning time	115 sec.	129.5 sec.
32. Burnout weight	7,500 lb.	1,200 lb.
33. Jettison	6,800 lb.	700 lb.
34. Velocity obtained	13,630 ft./sec. = 54.5% orbital	8,000 ft./sec. = 32% orbital
35. Height obtained	507,000 ft.	550,000 ft.
36. Total velocity now	21,690 ft./sec. : 14,750 mph.	13,400 ft./sec. : 9,140 mph.
37. Total height now	695,000 ft. = 131.5 mi.	740,000 ft. = 140.5 mi.
STAGE 3		
38. All-up weight	700 lb.	500 lb.
39. Length	12 ft.	5 ft.
40. Diameter	30 in.	20 in.
41. Mass ratio	0.55	0.76
42. Propellant weight	378 lb.	380 lb.
43. Propellant	Solid	Solid
44. Thrust	3,800 lb.	1,440 lb.
45. I_{sp}	270 lb.-sec./lb.	260 lb.-sec./lb.
46. Propellant consumption rate	14.0 lb./sec.	5.54 lb./sec.
47. Burning time	27 sec.	68.5 sec.
48. Burnout weight	322 lb.	120 lb.
49. Jettison	137 lb.	99 lb.
50. Velocity obtained	6,850 ft./sec.	11,600 ft./sec.
51. Height obtained	Not applicable	Not applicable
52. Total velocity now	~25,000 ft./sec.	~25,000 ft./sec.
53. Total height now	2,960,000 ft. = 560 mi.	~1,585,000 ft. = 300 mi.
54. Useful payload	185 lb.	21.5 lb.

ating at the same frequencies, and powered according to best information by chemical batteries, with little or no attempt at miniaturization. For the dog in Sputnik II, instrumentation for recording and telemetering heartbeat, body temperature, respiration, and associated biological data was provided. Because of the frequency used, it is assumed that some ionospheric propagation data was obtained.

It is further surmised that information on cosmic rays and air density was gathered and broadcast.

About the Author

Saunders B. Kramer is a physicist/mathematician in the Preliminary Design Department of Lockheed Aircraft Corp.'s Missile Systems Division at Palo Alto, Calif., and has been engaged in satellite work.

This article contains results of a survey Kramer recently completed on satellites now in orbit. The values cited for the Russian satellites represents speculation and calculation by the author—except for the very few numerics released by Russia. For the American satellites, the values are largely a collection of available data and calculations based on this information.

Orbit Lifetimes

Based on the published data on Vanguard and Sputnik, some orbit-lifetime calculations have been made; the results are presented in Fig. 1. For this figure, an atmospheric model was employed, adjusted to coincide with the demonstrated lifetime of the Sputnik I satellite body (not to be confused with the rocket case).

The parameter $B = C_D A/2M$ is assumed for the figure to be unity. For any vehicles for which B would have a different value, the number of revolutions should be divided by the calculated value of B. For example, B for Explorers I and III is equal to 2. For Vanguard I, B is equal to 8.7. The

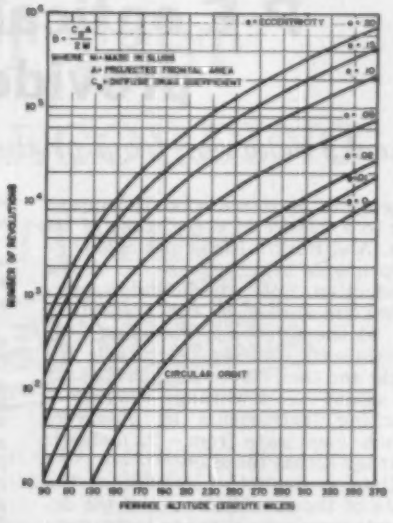
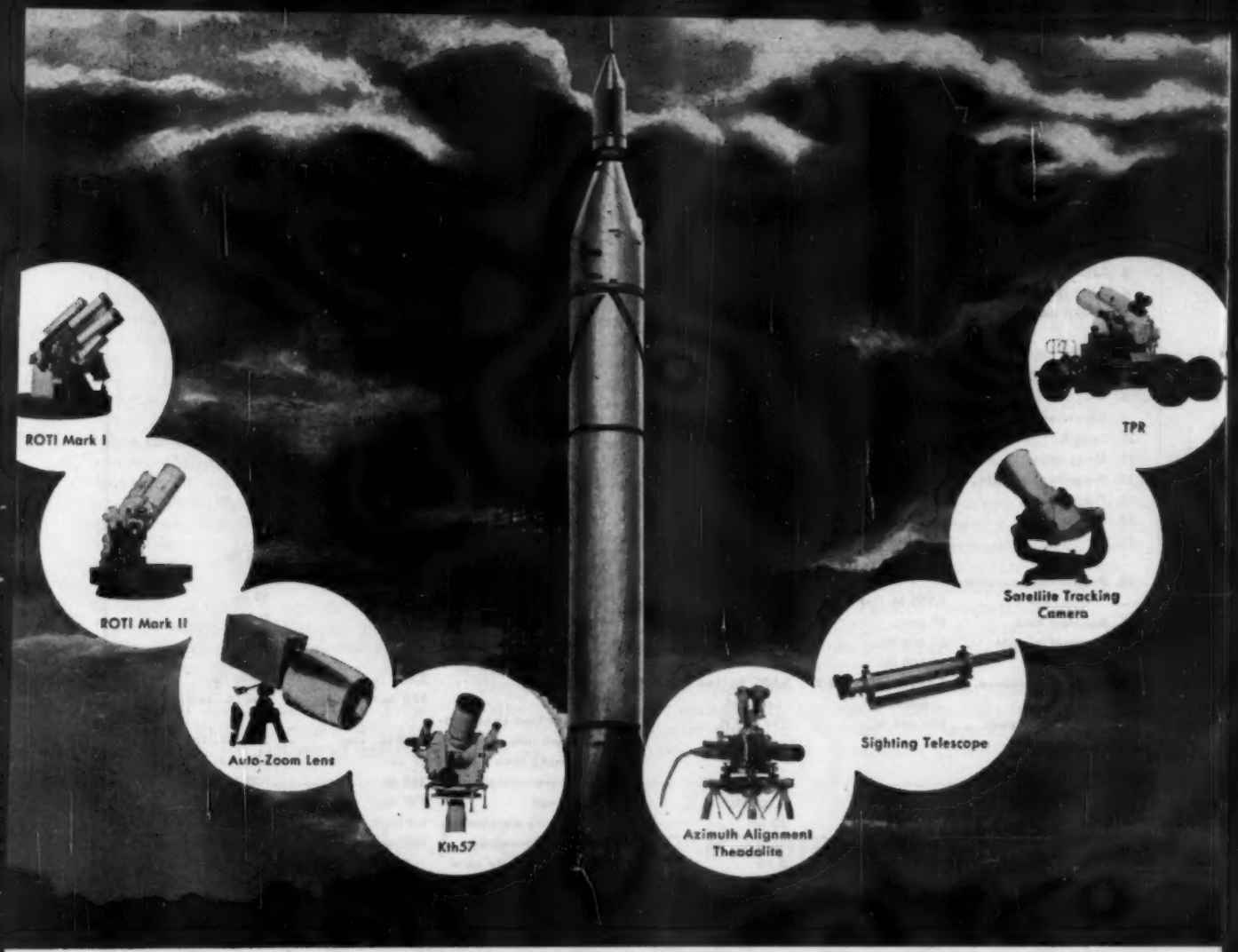


FIG. 1—Orbit lifetimes of Vanguard and Sputnik satellites. An atmospheric model was used, adjusted to coincide with lifetime of Sputnik I satellite.



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An interesting booklet, "Optical Tracking Instruments," describes these and other P-E instruments for the Space Age more fully. Write for it. *T.M.

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respective lifetimes of these satellites are therefore ½ and 1/8.7 times the number of revolutions obtained from the figure.

The inevitable question, of course, after examination of data and exploration of published parameters, is "How do the satellites compare?" This has been an abused and misused area of investigation, full of loaded questions and loaded answers, according to the inclination of the investigator.

Table III

In Table III, the comparison is physical rather than political. The full-scale Vanguard satellite vehicle is here compared with Sputnik I. The values given for Sputnik should be viewed as speculative, and no implication is intended that they are authoritative. Since they were presented at a meeting of the American Astronautical Society in October, 1957, many estimates on the Sputnik I data have appeared in the press.

The trickle of data from Russia via Great Britain and many publications in the United States lead to the belief, after extensive comparisons, that this set of calculations—albeit speculative—approaches the mark closer than any similar set of calculations thus far encountered.

The British Interplanetary Society Journal, "Space Flight," published in

Table II – Explorer I Instrumentation*

	Low-Power Transmitter	High-Power Transmitter
Transmitter power	10 mw.	50 mw.
Transmitter frequency	108.00 mc	108.03 mc
Antenna type	Dipole	Turnstile
Maximum effective antenna gain	− 2 db.	+ 1 db.
Maximum effective radiated power	+ 8 dbm.	+ 18 dbm.
Radiation polarization	Linear	Circular
Type of modulation	Phase	Amplitude
Amount of modulation (total of four subcarriers)	0.7 radians rms.	50 per cent
Subcarrier frequencies (standard FM/FM channels)	2, 3, 4, 5	2, 3, 4, 5
Measurement by channel assignment		
Channel 2 (560 cps)	Skin temperature, forward	Skin temperature, rear
Channel 3 (730 cps)	Nose cone temperature	Internal temperature
Channel 4 (960 cps)	Wire-grid micrometeorite detection	Microphone-amplifier micrometeorite
Channel 5 (1300 cps)	Cosmic-ray count	Cosmic-ray count
Expected life	2 months	2 weeks

Standard Subcarrier Channel Assignment for FM/FM Telemetry

Channel No.	Low-Band Limit (cps)	Band Center (cps)	High-Band Limit (cps)	Total Bandwidth (cps)
2	518	560	601	84
3	675	730	785	110
4	888	960	1032	144
5	1202	1300	1398	196

* From April releases in Aviation Week.

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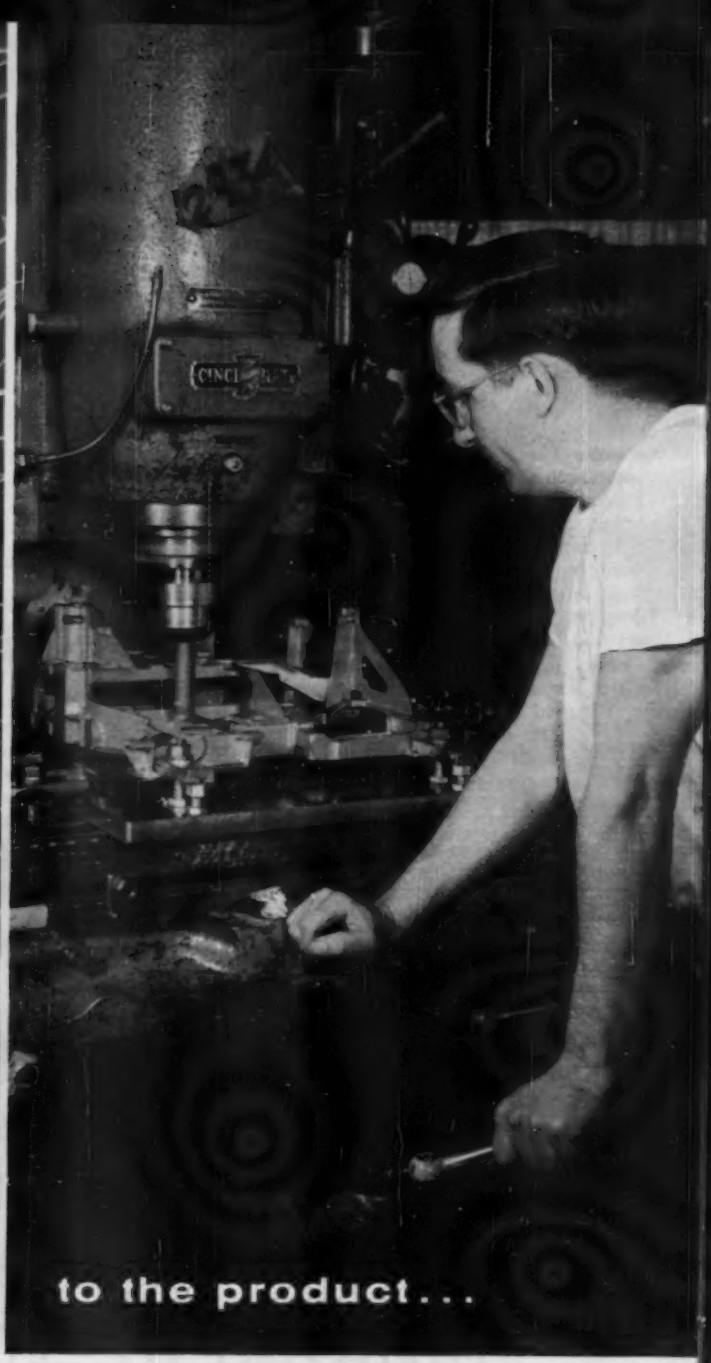

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January, 1958, information forwarded from Moscow on Sputnik I.

Among the data so published were figures of 264,000 lb. for the first-stage thrust, 4,500 mph. (6,600 ft./sec.) first-stage burnout velocity, 79,000 lb. for the second-stage thrust, and 12,000 mph. (17,200 ft./sec.) second-stage burnout velocity.

Weight Estimates

From data in this journal on the thrust levels and burnout velocities for the Sputnik trajectory applicable to the 184 lb. payload configuration, the following weights were estimated:

- Initial lift-off ..... 176,000 lb.
- Impulse propellant first stage ..... 118,000 lb.
- First stage burnout ..... 58,000 lb.
- Second stage launch .... 51,230 lb.
- Impulse propellant second stage ..... 36,886 lb.
- Second stage burnout.... 14,344 lb.
- Third stage launch..... 9,524 lb.
- Impulse propellant third stage ..... 5,524 lb.
- Third stage burnout.... 4,000 lb.
- Fixed weight ..... 1,876 lb.
- Payload ..... 2,124 lb.

Such a configuration satisfies an ICBM requirement for a ballistic range of 5,500 naut. mi. if the third stage is removed and a warhead added. If the Sputnik I vehicle comprised two booster stages and a solid-propellant final stage, it is reasonable to assume that the payload would be limited to approximately 184 lb.

Sputnik II would have featured a complete third stage; under those circumstances, performance limitations could have restricted the payload to the 1,120 lb. actually attained. With optimum performance, the payload can still grow to the 2,124 lb. shown, not including the structural fixed weight that must go into orbit with the payload.

If the Russian state of the art with respect to performance is lower than ours, the effect on these estimated data is simply to increase the initial lift-off weight, without changing the final payload weight If, on the other hand, their performance betters ours, the initial lift-off weight can be less. Again the payload remains the same.

Other Alternatives

The other alternatives are that the Russian state of the art with respect to propulsion and structure is lower or better than the present state here. Such change would decrease or increase the maximum payload shown.

An interpretation of the thrust levels as noted leads to a possible conclusion that the Russian ICBM performance level is slightly below our own; this would indicate an initial launch weight for Sputnik III higher than that shown

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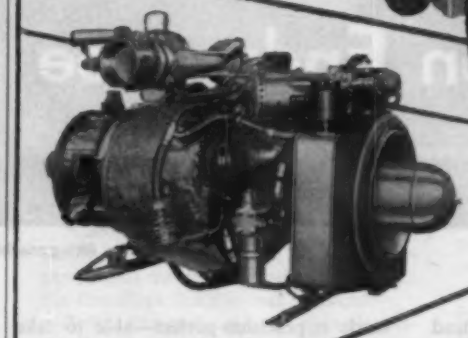

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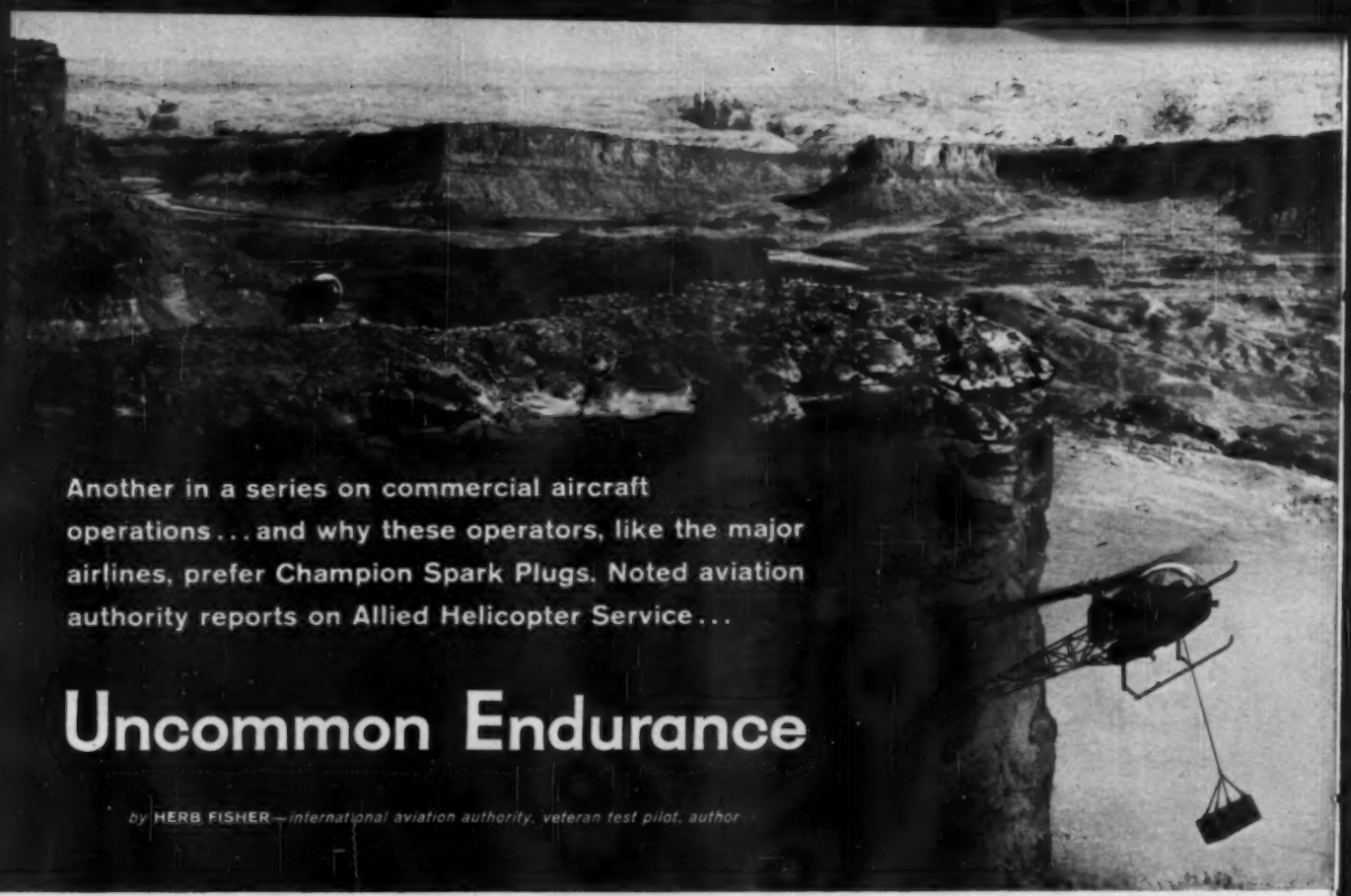


Another in a series on commercial aircraft operations . . . and why these operators, like the major airlines, prefer Champion Spark Plugs. Noted aviation authority reports on Allied Helicopter Service . . .

Uncommon Endurance

by HERB FISHER—*international aviation authority, veteran test pilot, author*

"Surveying, lifting machinery . . . bucking winds to hot, thin heights . . ."

The romance of the whirlybird is a dead duck so far as Allied Helicopter Service is concerned. Allied *works* its unglamourous craft—murderously.

Headquartered at Tulsa, this unusual eight-year-old "rugged-duty outfit" hires out on a world-wide basis—spraying, exploring, patrolling, surveying, hauling . . . frequently under almost unbelievably grueling conditions, jungle to Arctic.

As Roy B. David, Allied's President, told me: "For men, it's all *work*. For machines, it's just plain hell."

Herbert O. Fisher

A colorful Oklahoma attorney whose work in corporate aviation law led him to the founding of Allied, David speaks with undisguised admiration for his toiling helicopters:

"These are no dolled-up glamour birds. We tear them down, here in our shops—airframe to engine—down to the last nut and bolt. We custom-overhaul them from the ground up. We weld and innovate. We don't care how pretty they are. They've just got to be tough, beefed up to withstand terrific punishment.

"No engine goes in service until we've made it precision-perfect—able to take almost incredible overwork despite abrasive sand and humidity, subzero weather and hot, thin altitudes. That's why Champion Spark Plugs are so vitally important to us: *They insure dependability* of a good engine. Without a 100% dependable engine, you can wash out in short order in an operational grind like this."

SPRAYING, SEEDING

Allied's main operation now is crop and reclamation spraying—herbicides on pasture lands, forests, rights-of-way, canals and ditches, rice fields; insecticides on croplands, forests, cities—plus seeding of broadcast crops, pine forests, strip mines, grazing lands.

On the foreign front, Allied is spraying 50,000 acres of bananas per *month* in Guatemalan river-bottom. Eight 'copters plus pilot and mechanic crews are on the job. This operation represents a 5-million-dollar-a-year crop savings to banana growers, David said.

Rugged duty, for certain: With skids ofttimes touching banana leaves—darting in and out of jungle-bordered corners, day after day—each second of flight is critical. There can be no margin for error. Pilot, airframe and engine must be superbly *fit*:

"We pull our custom-tailored engines every 600 hours, clean spark plugs every 50," David said. "And fortunately for us, we can buy Champions in Guatemala City—as well as nearly any place else in the world.

"Helicopters, you know, work plugs much harder than do other aircraft, subject them to much severer operating conditions. When you consider that helicopter engines operate *constantly* at the high RPM that airplanes use only on takeoff — which means high electrode erosion and shorter plug life—this

Allied on oil survey . . . swamp near Morgan City, La.

should floor you as it has us:

"*Our plug life is 600 hours.*"

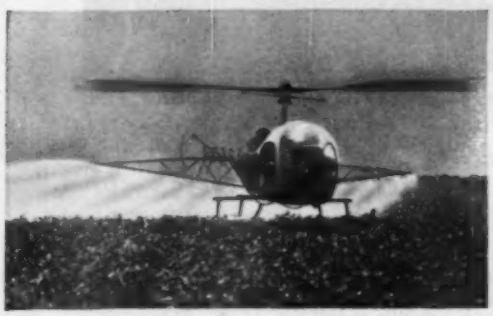
One of Allied's more spectacular home-front projects involves spraying 1,000,000 acres of mesquite in Texas and dense scrub in Oklahoma: "Remove that worthless mat and you'll have the best cattle country and farmland in the U.S.," reclamation experts had predicted.

"Carving farm and rangeland out of backcountry like that really gives our grasshoppers a workout," David told me. "And already a lot of that 'worthless mat' is cow-belly-deep in grass!"

On an "ordinary" herbicide and insecticide spraying job, I watched Allied 'copters clipping along the ground and shuddered. I watched them snuggle into corners of fields—right up to border vegetation and obstructions—then pivot sharply "at the last minute," spraying again, without drift, a return swath in three to five seconds. They'd land anywhere, anytime—taking on fuel and chemical in mere minutes. Then off again.

"That's real precision work," David said pridefully. "It's more than teamwork. Like the old cowhand and his horse, the helicopter pilot and his machine *must* operate as *one unit*. The man out there, Herb, is a *part* of his 'copter—and that engine is his heart. He wants it strong—fired to life by *dependable* spark plugs."

Allied has sprayed several thousand



"Spraying, skids raking foliage . . ."

miles of power line and railroad right-of-way from Texas to Illinois. A special controlled width device—developed by Ozzie York, Vice President-Maintenance and former RAF pilot—cuts a swath without harming valuable crops or timber to either side.

In Allied's vast forest and range reclamation projects, this equipment is used with chemicals that kill certain plant species without harming desirable vegetation: pine stands aloof and healthy, for example, while other trees and underbrush die.

SURVEYING

From Arizona to Alaska and Iceland, Allied has done government surveying and transplanting of heavy equipment and manpower where it's ofttimes impossible by other means.

In Iceland, Allied operated with the U.S. Army Map Service.

In Government uranium exploration in Alaska, Allied had to heat motor oil before it could be used: "I swear, when it's 40 below up there, I think we must have sometimes drunk the oil and poured hot coffee in the 'copters, so *un*romantic was *that* duty!" David said.

With the U.S. Geological Survey and Atomic Energy Commission, Allied 'copters invaded 17,000 square miles of some of the most inaccessible wilderness on earth—the Four Corners country of Utah, Arizona, Colorado and New Mexico. Here, Allied helicopters bucked wind currents from gorge bottom to heights where hot, thin air made hovering nearly impossible. They shuttled surveyors to hundreds of these pinnacles—averaging 8 to 10 miles apart — so they'd have abundant triangulation points for mapping 20- to 40-foot contour intervals. They lugged up machinery, explosives and timbers, and, between tasks—to test thermodensity lift—they'd haul boulders several thousand feet up from the canyon floors.

In Alaskan Geological Survey operations, 'copters pitched among icy mountains to cut field costs for mile-to-inch mapping from $25 a square mile to less than $8.

OIL EXPLORATION

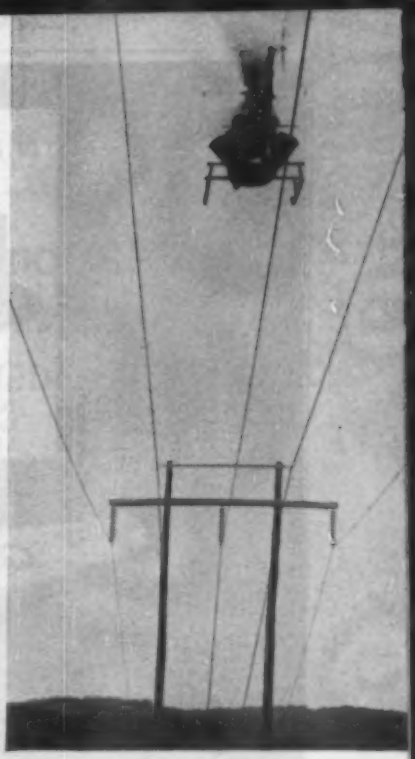
Allied has operated under contract to major oil companies from South American jungles through Louisiana swamps to the Canadian Rockies and Alaska.

Before first wells came in on now productive southwestern United States test sites, Allied whirlybirds were scouting the badlands for Gulf Oil. Explosives used in refraction shooting were shuttled quickly from "shot station" to "shot station" in this almost impossible country. Such treks previously took 100 men, each packing one case of dynamite, three days.

In Alaska and the Canadian Northwest, Allied's "grasshoppers" opened previously inaccessible areas for Phillips Petroleum, hauling supplies as well as flying geological survey missions.

In South America, Allied packed instruments, drills, explosives and camp supplies through dense jungles—covering in 45 minutes what had taken natives six

Night patrol . . . (r/l) Roy B. David, Allied President; Osvil York, V.P.-Maintenance



"Hustling along hazardous hot-wire trails . . ."

days to traverse. Here, Champions protected against hazardous flashover caused by hot, moist operating conditions.

In our own Gulf States, Allied air-lifted to isolated swamps everything from drilling apparatus to explosives. Seismograph crews didn't even get wet feet: the pontooned 'copters dragged surveyor chains, held the stake and flew sideways, up, down and backwards at the surveyor's signal.

PATROLLING

"Rugged" characterizes Allied's patrol duty, too.

With the Tennessee Valley Authority, for example, Allied 'copters skittered along 8,000 miles of high-voltage transmission line for 3½ years for a close check of line or insulator damage—impracticable by ground inspection.

On frost control projects in Oklahoma and Kansas, Allied flew low along telephone-telegraph lines so powerful rotor downdraft would jar accumulated ice off wires threatening to snap!

"Whether hopping about a pocked desert or combing bugs out of the jungles, it's *rugged duty* that you have to live with every day to really comprehend," David said. "It takes quite a crew, quite a craft, quite an engine—and, quite a spark plug. You can't buy a more serviceable, dependable spark plug than Champion. *We know*. We've got the operation to *prove* it —as I used to say in the courtroom—'beyond any shadow of a doubt.'"

CHAMPION SPARK PLUG CO.
TOLEDO 1, OHIO

Three Gnat Gyros in Honeywell Three-Axis Turn Rate Transmitter. Size: 8.6" x 6.3" x 5.24". Weight: 5 pounds.

Convair F-106 all-weather jet interceptor incorporates Honeywell Three-Axis Turn Rate Transmitter in flight control damper system

Three-axis control at *all* speeds and altitudes

Gnat Rate Gyro shown ⅓ size. Weight: 3.8 ounces.

The Honeywell Three-Axis Turn Rate Transmitter, featuring three Gnat miniaturized gyros, was selected for the new Convair F-106 "Delta Dart" all-weather jet interceptor. Built into the stability augmentation sub-system of the jet's flight control system, the Transmitter detects rate of turn about the yaw, pitch and roll axes and responds with an output signal whose voltage is proportional to these input rates of turn.

This system is designed to operate under the most severe environmental conditions to which a combat aircraft might be subjected. The Honeywell Gnat Rate Gyros are easily capable of withstanding the severe shock, vibration and temperature requirements of this application and as such are mounted directly upon the base casting without shock mounts to optimize dynamic characteristics of the system.

The electronic portion of the Turn Rate Transmitter amplifies and demodulates the Gyro output signals to provide polarity reversing d-c outputs proportional to the corresponding input rate to each Gyro.

Investigate Honeywell's ability to develop, engineer and produce flight control systems for today's most advanced aircraft and missiles. Write for Bulletin GN to Minneapolis-Honeywell, Boston Division, Dept. 11, 40 Life Street, Boston 35, Mass.

Honeywell

Military Products Group

above. The payload should still weigh between 2,000 and 2,500 lb.

Sputnik III's radio frequency on signals is 20.005 mc. A second frequency, which could be a second transmitter or harmonic of the first, is at 40.01 mc. The Russians may make a try at re-entry and an ablation shield may be included in the cone to protect the capsule. Lockheed Missile Systems Division has noted that the cone is tumbling at about 4½ rpm.

REFERENCES

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AVIATION WEEK, various 1958 releases.

Star Tracking Unit Operates in Daylight

Hawthorne, Calif.—By long focal length electronic scanning of infinitesimal sector of sky, automatic star tracking system developed by Northronics Division of Northrop Aircraft, Inc., can operate during daylight as well as night hours.

Unit scans so small a part of sky that high ambient light of normal daytime does not affect its ability to locate, lock on, and track a star, even one fairly close to the sun, according to Northronics. Small amount of light differential produced by the star being tracked, in comparison to normal light in the part of sky being scanned, is amplified by the system to a quantity usable for lock-on and tracking.

Scanning and tracking system will be usable for space navigation as well as for stellar guidance system for guided missiles such as Northrop's Snark, Northronics points out. It also can be used as a check on inertial navigation systems when not an integral part of an automatic stellar navigation system.

Kodak Studies Problems Of Missile Photography

Investigation of problems involved in photographing missiles in flight reveal that the effectiveness, resolving power and sharpness are improved as film sensitivity decreases. Therefore, the "slowest" film that can be exposed in the system is usually the most effective.

Research, in progress at Eastman Kodak, Rochester, N. Y., also brings out the importance of correct exposure in photographing missiles. Kodak reports that with incorrect exposure, smaller missiles can be completely lost.

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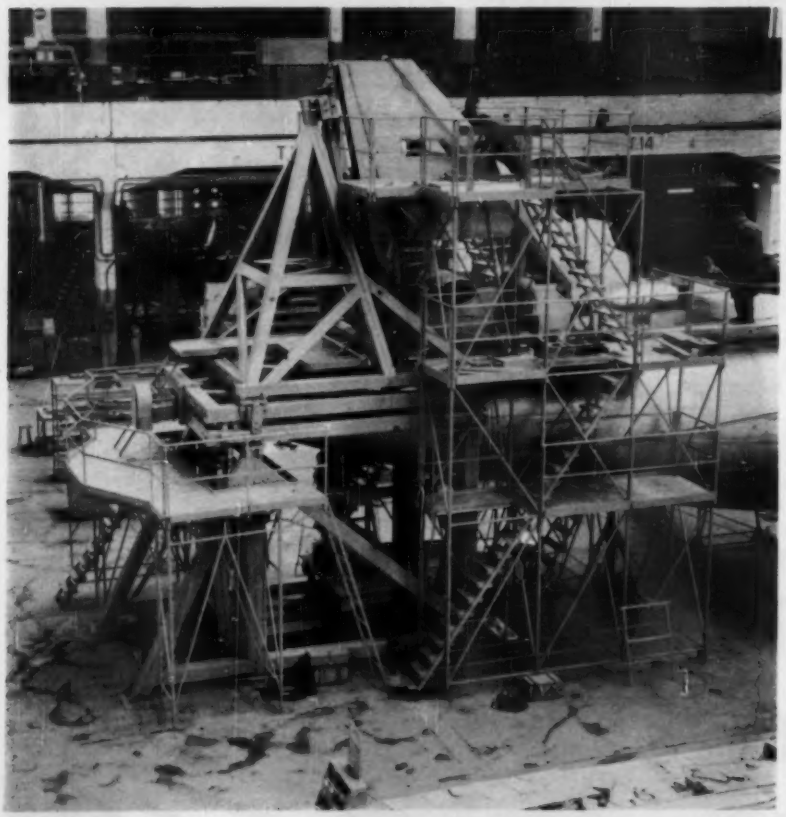
CARAVELLE No. 1 prototype, carrying Scandinavian Airlines System markings, touches down after another in series of flight tests.

How Sud Builds Caravelle Jet Transport



VERTICAL tail jig is massive triangular structure fitted to second Air France Caravelle.

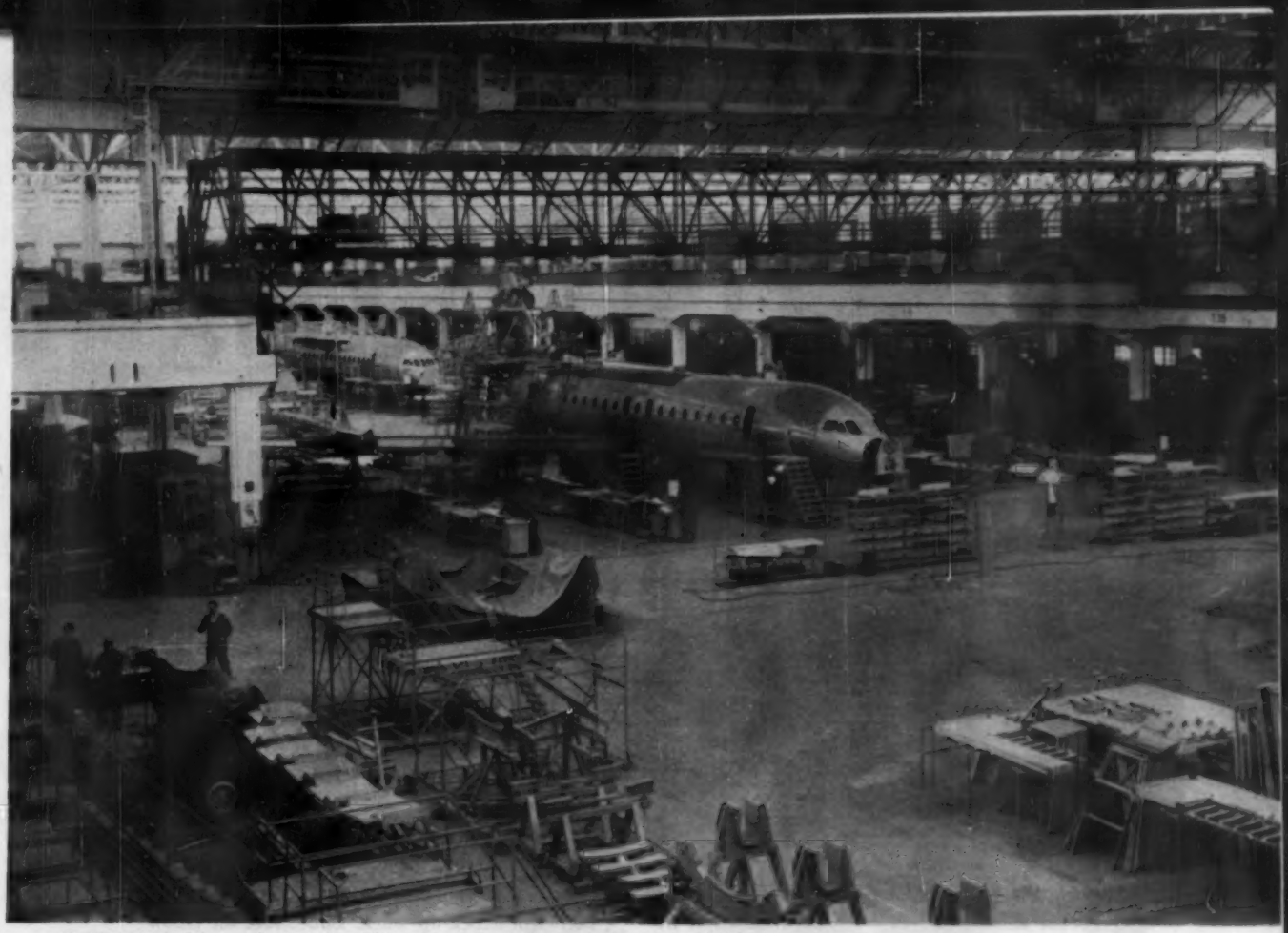
By David A. Anderton

Toulouse, France—Sud Aviation's first production Caravelle, soon to be delivered to Air France, has been rolled out of the final assembly area here.

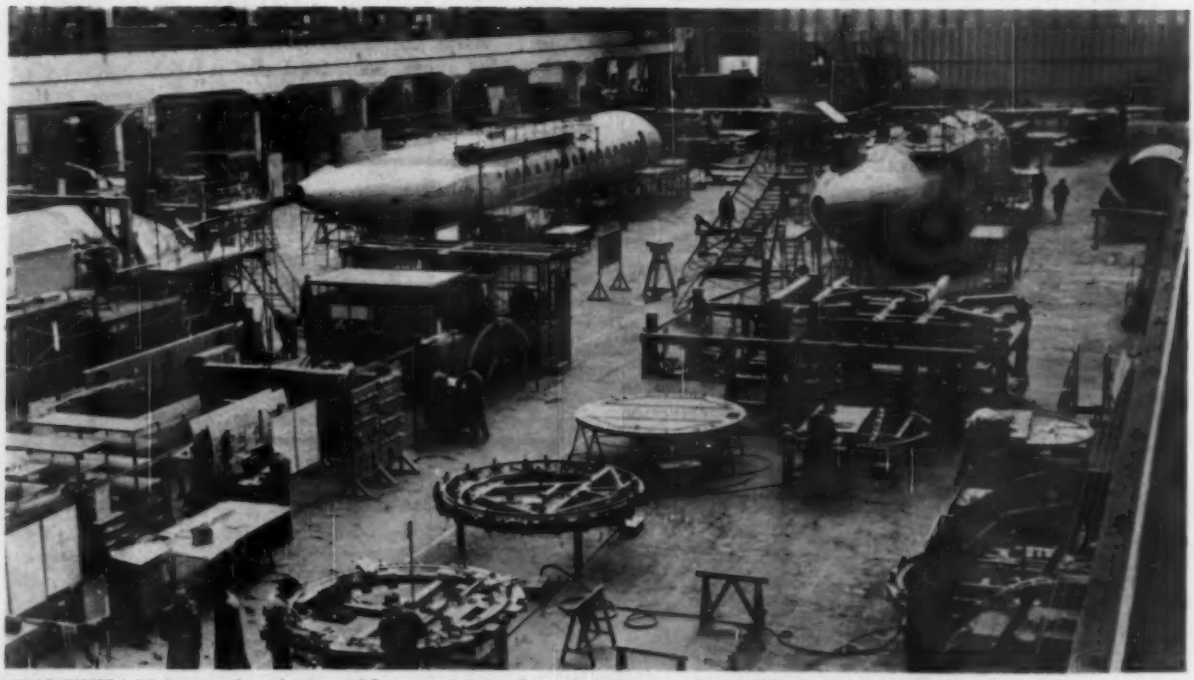
Behind it on the line are about one dozen more, destined for both the French national carrier and Scandinavian Airlines System. Air France gets six and SAS gets six of these first 12 production planes. Both carriers expect to introduce the twin-jet aircraft into European service next year.

Total firm orders for the Caravelle are for 26 airplanes: Air France has bought 12 and has an option on 12 more; SAS bought six and has optioned 19; Varig has ordered two, Finnair O/Y bought three and Air Algérie purchased three. Delivery schedules call for all firm orders to be filled by April, 1960, at the latest. Thus Sud Aviation is committed to deliver only 26 Caravelles during the next two years. It is this low average delivery rate that has caused so much misunderstanding about the capacity and the ability of the French firm to turn out airplanes.

After visiting any of the production factories operated by Sud, a technical observer is impressed by Caravelle tooling, which reflects latest techniques in quality and quantity production. Scheduling, quality control, visual aids for assembly-line workers, factory lay-



WING STRUCTURE and vertical stabilizer attached, Air France's second production Caravelle moves toward completion.



WING-FUSELAGE intersection changer (right center) is used to guarantee interchangeability of this critical connection.

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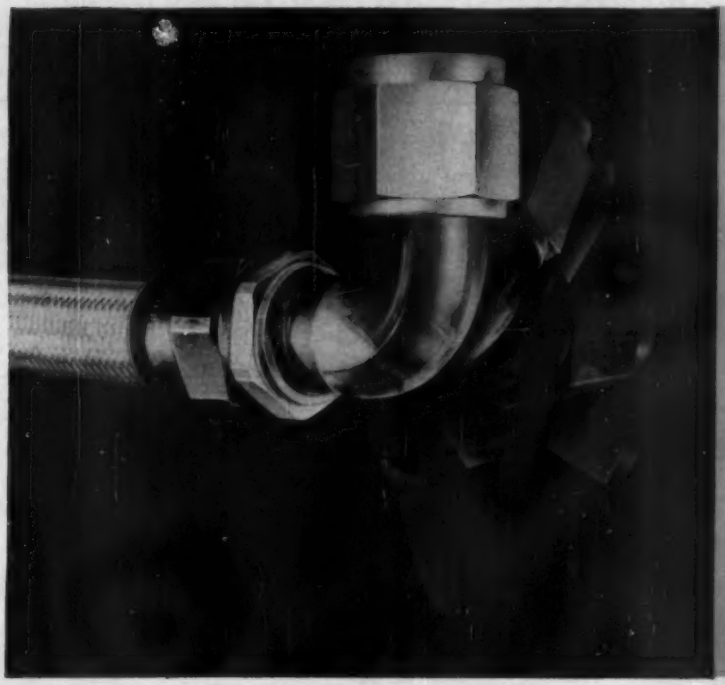

adjusts 360° with no loss of grip

BASIC GRIP NEVER LOOSENS

Socket and unique lockring in SEAL-LOCK fitting exert unshakable grip on hose. Once applied, this hold need never be disturbed when adjusting elbows. Lockring keeps initial grip strength no matter how much or how often elbow is swiveled... *an exclusive* SEAL-LOCK *safety feature*... extra blow-off insurance.

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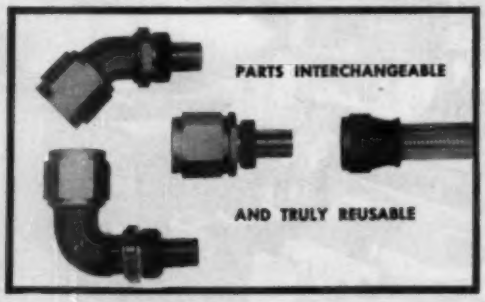

Originators of high temperature fluorocarbon hose assemblies

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outs, all are on a par with the best in the United States. Man-hours of labor per pound of airframe weight also compares directly to the figures reached in the United States.

In spite of this, the feeling persists—particularly among American and British engineers—that Caravelle production is too slow. It's probably the result of comparisons, made without too much attention to the circumstances, that has produced this feeling.

For example, both Boeing Airplane Co. and Douglas Aircraft Co. will complete deliveries of their current firm orders for jet transports by the summer of 1960, according to their present schedules. Each firm will have turned out about 150 four-jet transports during the same time interval that Sud will be delivering 26 twin-jet transports of much smaller size.

But the number of employes who are responsible for transport production in the Douglas Santa Monica division probably is about the same as Sud's total employment of approximately 22,000. And besides the Caravelle, Sud is building parts for other French firms under subcontract, plus its own Vautour all-weather fighter-bomber, the Alouette helicopter, and a limited number of experimental and development planes like the Trident and Baroudeur, plus some effort on missiles.

Total number of persons, including the subcontractors, working on Caravelle production is about 8,000.

Even this does not make the Caravelle production compare directly with that of the Boeing 707 series or the Douglas DC-8s. Many other factors enter the Caravelle picture. Some of them must be understood before any valid comparisons can be made between Sud's production rate and that of any other company.

Production Problems

Ask an American production engineer if he would like to have the job of producing airplanes in France. His first reaction is almost certain to be strongly negative, not because he believes the French don't know production, but because he has some knowledge of the environment.

American production experts, visiting Europe for the first time, are invariably impressed with over-all knowledge of production problems and the applications of new techniques. What they don't generally see are the difficulties that beset a company at every turn:

• **French governmental instability** has a demoralizing effect on administrative levels in private industry. "How can we plan a long-range program," said a French engineer, "when we won't even know if we will have a budget tomorrow?"

• Successive devaluations of the franc,

new BRIDGEPORT AIRCRAFT VALVES
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HOW CAN AN ANTI-MISSILE MISSILE TELL A DECOY FROM THE REAL McCOY?

TO CONFUSE anti-missile missiles, an incoming missile may explode its final stage rocket casing as it approaches target. The resulting fragments would surround and travel with the missile, acting as decoys.

This is only *one* of the AMM guidance and arming-fuzing problems.

There is also the fantastic closing speed of the two missiles which allows only seconds to resolve and relay course correction data to the launched AMM. And there are environmental problems of extreme acceleration, vibration, velocity and heat that exceed even those found with ICBMs.

At Honeywell, however, solutions are in sight.

The decoy problem may be solved by detecting a piece of the enemy missile near the center of the fragment cloud and ignoring individual pieces. Or, if the fragment cloud does not exceed the effective explosive radius of the AMM warhead, the AMM fuse can simply act on the entire cloud.

For further information, contact Minneapolis-Honeywell, Military Products Group, 2753 Fourth Avenue, South, Minneapolis 8, Minnesota.

The fuzing system for Sidewinder is now being manufactured by Honeywell in quantity. And Honeywell is also producing systems, sub-systems and components for ASROC, Wagtail, Thor, Titan and many classified missiles. This broad systems experience makes Honeywell the 'logical company for anti-missile missile development work.

Honeywell

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What's new in TITANIUM welding:

Resistance and fusion welding as fabrication procedures have become increasingly important with the advent of missiles and aircraft designed for sustained operation at Mach 3 and better.

Titanium alloys are available which provide fusion-weld efficiencies of 100 percent, and spot-welded joints with excellent load carrying capacities.

Through its new Toronto, Ohio, rolling mills —designed specifically for titanium operations —Titanium Metals Corporation of America can provide light-gage flat-roll weldable products of consistently highest quality, on the fastest delivery schedules, at the lowest possible price in the industry today.

Q. What are the leading welding grades?

A. Ti-75A, a single-phase unalloyed grade which is readily formable; Ti-5Al-2.5Sn, a single-phase alloy grade which provides excellent resistance to oxidation up to 1200°F; and Ti-6Al-4V, a duplex-phase alloy grade with guaranteed minimum tensile strengths to 130,000 psi. Guaranteed minimum mechanical properties of these grades are:

GRADE	DENSITY	Guaranteed Room Temperature Properties		
	lb/cu in	0.2% YS	UTS	Elong. % in 2"
Ti-75A	0.163	70,000	80,000	20
Ti-5Al-2.5Sn	0.162	110,000	115,000	10
Ti-6Al-4V	0.161	120,000	130,000	10

Q. Are special precautions required for welding these grades?

A. Titanium is spot-welded more readily than aluminum and many of the carbon and low alloy steels, and requires no special precautions. Spot-weld machine settings used for titanium and stainless steel are very similar.

Titanium is fusion-welded with inert-gas-shielded arc welding techniques and joint designs which are also similar to those used for other metals. Two fundamental principles must be considered:

1. Coated electrodes and other fluxing compounds cannot be used.
2. Titanium weld joints must be shielded from the normal atmosphere with an inert blanket of argon or helium during welding.

Q. Does that mean chambers are mandatory for fusion weldng?

A. No. Open air welding is adaptable to production operations when both root and face of the weld are protected from the air. Small parts and complex shaped weldments which are difficult to shield adequately may still be welded more easily and economically inside a chamber. This is described in detail in TMCA's publication, *Titanium Welding Techniques*, Engineering Bulletin #6.

Successful titanium welding techniques have enabled fabricators to produce missile propellant storage bottles which resist internal pressures of 8000 psi at —300°F. This all-titanium bottle, produced by Rheem Manufacturing Company, Downey, Calif., is Ti-6Al-4V, fusion-welded in an argon atmosphere. Designers say use of titanium bottles can add up to 700 miles to the range of an IRBM.

Q. Are titanium welds more susceptible to corrosion attack than the base metal?

A. Titanium welds offer the same excellent corrosion resistance as the base metal. Stabilizing heat-treatments, employed with many other materials, are *not* required.

Successful welding is a key factor in today's designs. It enables designers to draw upon titanium's unique combination of properties: light weight, corrosion resistance, and ability to withstand operating temperatures from –300°F to 1000°F — for the added performance vital to these uniquely critical times.

Titanium Metals Corporation of America has just completed the first comprehensive study of welding techniques yet published by the industry. This 32-page publication draws upon metallurgical considerations to recommend and explain techniques required for quality titanium weldments.

Titanium Welding Techniques, as well as other publications, in the most extensive data library in the industry, is available from Titanium Metals Corporation of America, 233 Broadway, New York 7, New York. This important literature is yours for the asking.

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- ☐ Bulletin 4 Mechanical Testing of Titanium
- ☐ Bulletin 5 Properties of Ti-155A
- ☐ Bulletin 6 Titanium Welding Techniques
- ☐ Other .....

NUMBER two prototype's dorsal fin has been extended forward on fuselage top for antenna.

unintentional or intentional, have wreaked havoc in cost control.

• **French law specifies** a three-week vacation for labor during the summer. Most companies comply with this by shutting down for the period. Sud closes during August, so that the holiday knocks a full three weeks out of the production year.

• **"Add to this the strikes,"** said another engineer, "which never take less than seven days out of our work year, and you find that you are scheduling for an 11-month year."

• **France recognizes** 11 legal holidays compared to eight in the U. S.

Other Factors

The strikes, even though they last for a short time, have a way of affecting production for longer periods. The recent 24-hr. transportation strike in France stopped the motion of all goods by road and rail, sea, canal and air. Railroad yards and truck terminals and docks filled with undelivered wares.

Sud Aviation at Toulouse, which receives Caravelle components from all over France, was hit like every other plant. Deliveries of assemblies stopped. In the early stages of production build-up, there had been little time to stockpile parts, and such a shortage was felt quickly. Furthermore, its effect is not directly proportional to the number of days delay, but something like a hyperbolic function where the production delay shoots up out of all proportion to the actual time lost.

On top of all this is the French labor pool, a problem for all the country's industry. "The only way we could build more Caravelles is to get more people down here," said a Sud executive. "We would have to build housing, schools, shops, churches, cafés and sport grounds and even then they would say, 'Why should we move down there? We like it here!' And they would stay right where they are now. That's why we take the work to the workman; that's why the Caravelle is built in 11 different locations."

Caravelle components and major assemblies are manufactured in six Sud plants and by five major subcontractors. Production breakdown is like this:

• **Basic wing box structure** is built at Sud's Bouguenais factory, near Nantes on the Bay of Biscay. This factory has

Caravelle Details

Dimensions: Overall span of the 20-deg. swept wing is 112 ft., 6.4 in. Fuselage is pressurized for 85 ft. of its over-all length of 104 ft., 10 in., which is also the maximum airplane length. Height to the tip of the vertical tail is 28 ft., 6 in.

Weights: Maximum takeoff gross weight is 94,800 lb., maximum landing weight is 90,400 lb. Weight empty is 51,800 lb.

Seating: Internal arrangement provides space for either 64 first-class passengers, four abreast, or 80 tourist class passengers in five-abreast seating. Each row of seats has a window.

Powerplants: Two Rolls-Royce Avon 512 turbojets, commercially equivalent to RA.29, each rated at 10,500 lb. sea level static thrust. Prototypes have Avon 526 engines.

Performance: Guaranteed cruise speed 445 kt., equivalent to Mach 0.77. Maximum range not using reserve fuel, is 1,950 stat. mi. with tourist loading and 2,200 stat. mi. with first-class loading. Takeoff run with one engine cut at critical point, according to CAR 04b and with takeoff weight of 94,800 lb., is 5,400 ft. Landing run under same CAR requirements and 90,400 lb. weight is 3,300 ft.

Costs: Figured by the Air Transport Assn. method, direct operating costs for the Caravelle are quoted at about 1.2 cents per naut. mi. over an optimum range of about 1,200 naut. mi.

Price: Advertised last year at approximately $1,950,000.

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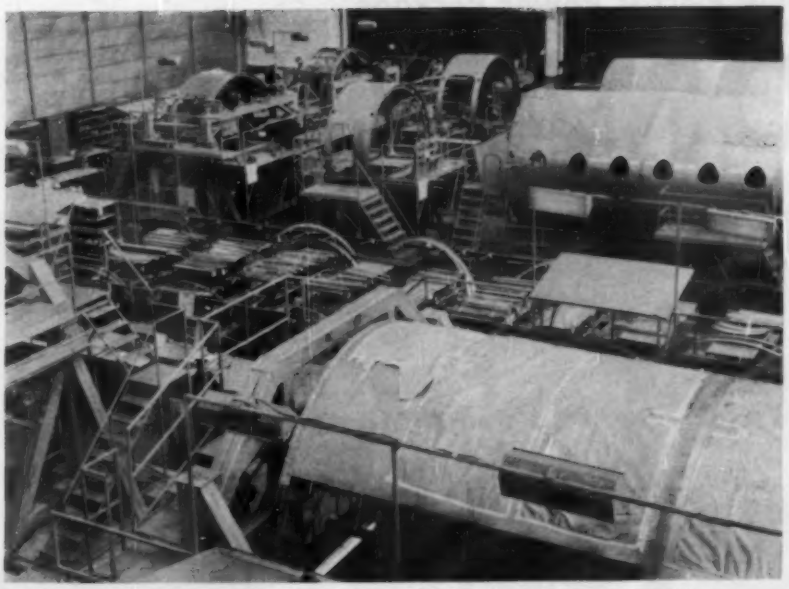

RING structure (left rear) is first stage of Caravelle No. 10 production. Ring with doors on both port and starboard sides is forward section of fuselage between cockpit and cabin.

one of the largest collections of machine tools in Europe, housed in almost 1,000,000 sq. ft.

• **Wing rear section** and leading edge are produced by the Saint-Nazaire plant, also near Nantes. Primary responsibility of this shop is Vautour production, and the buildings are set up for both component production and final assembly of complete aircraft. Total floor area is about 750,000 sq. ft.

• **Flaps are made** at Rochefort, between Nantes and Bordeaux. Major product here is the tail unit for the Vautour and Djinn helicopters. Floor area is about 280,000 sq. ft.

• **Forward fuselage section** is built at Marignane, near Marseilles. This sprawling complex of buildings has a covered area of about 800,000 sq. ft.

• **Rear fuselage** is subcontracted to the Société Latécoere, in Toulouse.

• **Engine nacelles,** horizontal and vertical stabilizers are subcontracted to Fiat s.p.a. in Turin, Italy.

• **All control surfaces** are produced by another subcontractor, Forges de la Boissiere.

• **Landing gear design** and production is the responsibility of Société Hispano Suiza, formerly a major engine producer but now making important contributions to landing gear design.

• **Powerplants** are Rolls-Royce Avon 512 turbojets supplied by the British company.

• **Fuselage cylindrical section,** final assembly and flight test is handled by Sud's complex of plants near Toulouse. Caravelle prototype shop and design offices are at Blagnac. General production engineering, machine shops, riveting and spotwelding is done at St. Eloi. Final assembly line and the flight test area is at St. Martin-du-Touch. Total area of the three Toulouse plants is almost 1.5-million sq. ft.

At the beginning of April, major components for the first 10 Caravelles were either in assembly stages or completed and waiting installation. Two prototypes were flying, the first production plane for Air France was being rolled out, the tank-test fuselage was being installed in the water-test facility and the static-test airplane was about ready to start its program.

Almost all of the final assembly area had been cleared for spotting of the airplanes being readied for flight. A few small jigs and fixtures remained from earlier production programs, but these were fast disappearing.

The final assembly hall at the St. Martin plant is about 700 ft. long and 300 ft. wide, and can be thought of as holding three bays: fuselage center section build-up, airplane build-up, and final assembly and pre-flight.

Fuselage build-up is conventional, with circular rings and frames built on horizontal jigs to one side of the assembly area. Pairs of these rings are set into jigs at the rear of the hall and skinned, to form a complete annular structure including the fuselage door. The rest of the fuselage is built up in four lengthwise panels on separate fixtures. Two of these are simple upper and lower shells consisting of partial ring formers, stringers and skin. The other two are window panels. All four are assembled in jigs at the next line station after the ring buildup.

At this station, fabrication work of the Toulouse plant ends, and the components made in other locations begin to feed into the line. Stations 30 and

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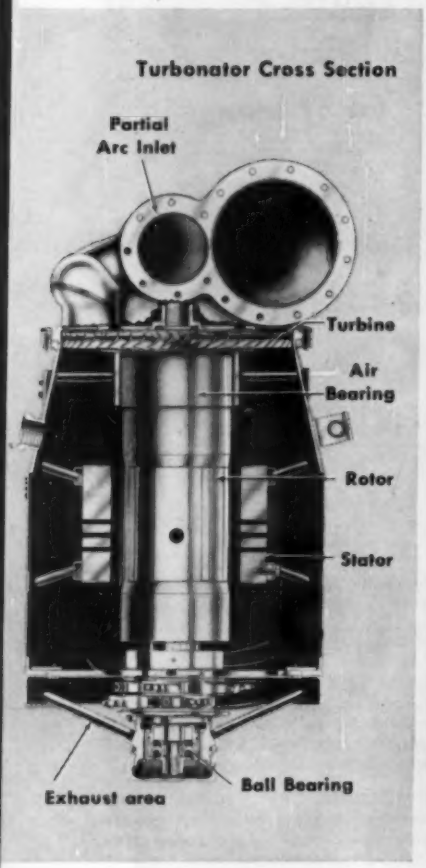

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31, next down the line, are build-up locations for the complete fuselage. Finished fuselage structures leave these jigs for four stations on the line: 32, 40, 41 and 42.

These four stations start the interior installations and basic systems that go with the fuselage. Meantime at the next line station, a set of wings is being readied for the first fuselage out of the installation fixtures.

Fuselage and wing are joined and moved down the line to station 50, where a huge triangular jig is used to install the vertical tail onto the stub fin.

From here the airplane moves sideways and forward to the spotting area, where it will receive the horizontal tail, engine nacelles and powerplants, and be completed and cleared for pre-flight checks.

Caravelle Walk-Around

First impression of the complete Caravelle is that it is a little airplane, low-slung and lovely. You can reach up and touch the wingtip; you have to squat to get under the fuselage. A few steps up a ladder, and you can look into the engine inlet or tailpipe.

Dimensionally it is within a few feet in each direction of a Douglas DC-6B, and yet the Caravelle looks much smaller.

Since the prototype was designed and built there have been only a few changes in appearance. The leading-edge wing flaps used on the prototype have been eliminated on production airplanes and fixed on the prototypes. The Rolls-Royce Avon engines have been moved forward to improve center of gravity position, and nacelles are longer as a result. Engines now have tailpipes and these are angled inward to reduce even further the already small dissymmetry of single-engine operation. Dorsal fin has been extended forward along the top of the fuselage for a communications antenna.

Inside the aircraft, two more rows of seats and windows, and the corresponding fuselage length, have been added. Additional a.c. electrical capacity will go into the production deliveries for galley equipment. The de Havilland Comet nose, which was originally bought intact from de Havilland, has been completely redone inside to match Air France, SAS and other airline requirements and to meet many of the instrumentation standards set by pilot and engineering groups.

One noticeable external feature of the Caravelle is the drag parachute, which Sud lists as "suggested" equipment for an operator. Normal landing runs of the plane are very short, something on the order of 3,300 ft. under the conditions of CAR 04b. But if the brakes fail, the operator will appreciate the insurance of the drag chute. Sud

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engineers believe that thrust reversers are some distance off yet.

A little detail is the rectangular hole in the big wing fence, which has been supposed to be everything from a stall-warning indicator to a Mach meter. It has four fine wires strung across the opening. Actually it is a fuel system vent, located in an area of moderate negative pressure. The wires are to keep out birds which nested in the cut-out when the prototypes were in the hangar.

Sud's Toulouse engineering and design teams, headed by Pierre Satre, chief engineer, and Étienne Escola, chief designer, have produced an outstandingly good airframe and aerodynamic layout, most engineering observers agree. From the over-all concept, which set the now-popular tail layout for jet engines, to the detail design, the Caravelle shows the result of careful and contemporary design engineering.

One example is the use of circumferential straps around the engine bay section as crack stoppers, or as fail-safe structure. These straps have been tested extensively in England by the Royal Aircraft Establishment (AW Mar. 10, p. 45) and in the United States by the National Advisory Committee for Aeronautics.

One other example is the air conditioning system, which provides one pound of fresh air per minute per passenger, is completely muffled. "It wouldn't have been necessary if we had propellers to mask the noise," said an engineer, "but the interior is so quiet otherwise that the air-conditioning sounded like Niagara."

A third example is a special extrusion used for major structural frames in the fuselage. This is a channel section of conventional size, but about halfway down the web of the channel the engineers specified a bulb to act as a crack-stopper at cutouts in the extrusion.

Fatigue Life

Structures engineers under Paul Vallat had two basic goals: long fatigue life of the structure and a fail-safe design. To achieve these they decided to eliminate every possible structural discontinuity. This has been carried down to the finest detail; adjacent, non-fastened parts in flexing areas have been carefully separated so that there is no chance for them to rub together in flight.

The wing box is a continuous and integral layout with no cutouts anywhere. Landing gear, flap and aileron loads are taken into the box through forged heavy ribs. Landing gear retracts into the fuselage so that there is no cutout necessary in the wing. Box has three vertical webs; if a crack should spread suddenly across a section of skin between two of these webs there would still be a closed box to take torsion loads and the other skin and webs to take bending and drag loads.

Wing box is made in halves, joined on the airplane centerline by pin joints between both upper and both lower skins. Each joint is further braced by a vertical tube between upper and lower joints, plus a pair of diagonal tubular members that tie the joints laterally to the face of the inboard heavy rib.

The circular-section fuselage starts by being an optimum shape for pressurization. Its construction is quite conventional, with thin skin and stringers plus the usual structural bulkheads. Floor beams tie across a chord of the circular section, and the chair rails and floor stringers are set into the cross-beams.

Just forward of the engine section and from there aft, the simple rings of the fuselage are replaced by built-up structural bulkheads, with truss-formed sections to take the loads imposed by the powerplants.

Windows and emergency exits have large corner radii; the window shape is unusual, and was dictated largely by considerations of avoiding stress-raisers in the design. Window centerlines are located on the fuselage frames; the window frame itself carriers the fuselage frame load through the discontinuity. In addition, stringers connect the maxi-

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Power output	50 watts	100 watts
Regulation	better than 8%	better than 8%
Ripple	1% or better, depending on requirements	1% or better, depending on requirements
Efficiency	up to 80%	up to 80%
Maximum mounting base temperature (operating)	+85°C.	+85°C.
Minimum operating temperature	−40°	−40°
Storage temperature	−65° to +100°C.	−65° to +100°C.
Weight	1 lb. 4 oz. (50-watt unit)	1 lb. 3 oz. (100-watt unit)
Size	4½" x 2¼" x 2⅛" (minimum)	5" x 3" x 3" (minimum)

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The Air Torq starter is manufactured only by Pre-Flite.

mum-width portions of the window frame to each adjacent fuselage frame. An inner skin with lightening holes is riveted to the inside of the fuselage stringers around the window panels for further strength of the area. Double plates are spotwelded to the inside of the fuselage skin at the window frames as a further precaution.

Supplementing the design calculations is an extensive test program beginning with structural-material coupons and going on through subassembly and components to the complete airplane. Working with Sud engineers on the test program is the staff of the nearby French government test center, Etablissement Aéronautique de Toulouse (EAT). Water-tank tests of the Caravelle fuselage will be done by EAT, and much of the special testing on brakes, landing gear, and fatigue life has been done there also.

Flight Test

Caravelle F-BHHI, the second prototype, made its 349th test flight on April 1 to check the installation of a new Rolls-Royce Avon engine done the previous night. Program called for a climb to 35,000 ft. on both engines, then a shutdown of the port engine, relighting, and single-engine operation on the port engine to run it through the conceivable flight range.

Takeoff gross weight was 77,300 lb., well below normal gross. Ground checks and engine starts completed, we taxied out to the main runway at Sud's St. Martin flight test center.

Taxiing seems smoother than any other airplane, due to the springing in the Hispano-Suiza landing gear. Taxi strip was blacktop with the usual roughness and waves, yet there was none of the pitching or bumping usually felt during the ground run of most airplanes.

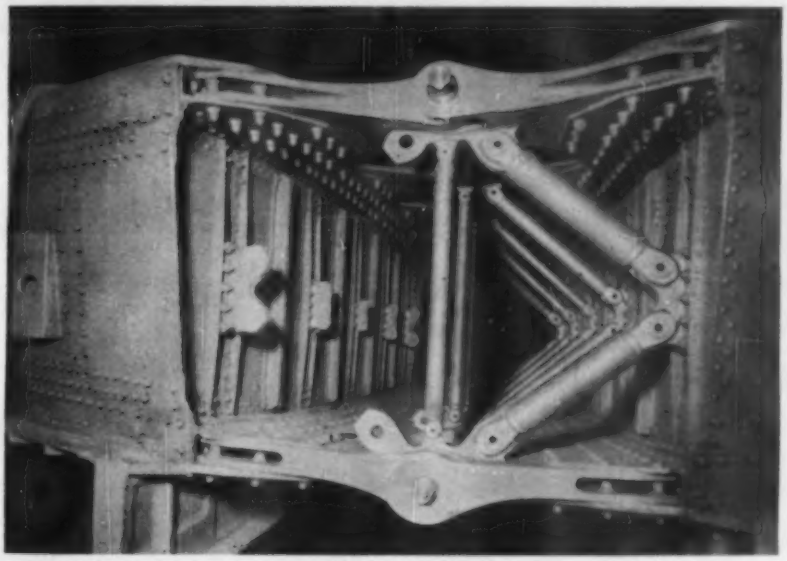
There was a brief moment of high noise level as Sud test pilot Pierre Nadot opened the throttles to full thrust and then released the brakes for takeoff. Within five seconds the noise level inside the cabin dropped appreciably and continued to decrease.

Takeoff acceleration is rapid and initial climbout is like a fighter. Nadot trimmed the Caravelle for a steady rate of climb through thick rain clouds and moderate turbulence and we bored silently upwards in the gray atmosphere.

We broke out at about 15,000 ft. and continued to climb. One of the flight test engineers set the tape recorder going, playing subdued piano music. The music completely masked all the engine noise.

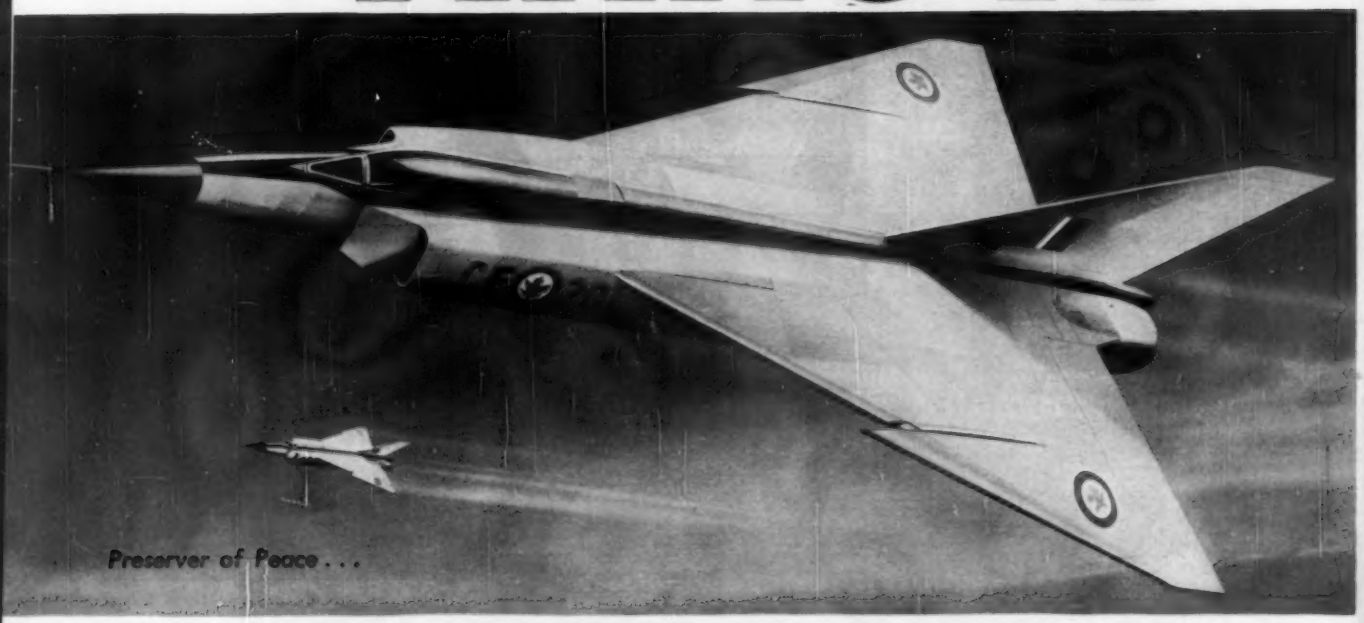
With the music off, we explored the airplane to get some qualitative impressions of the noise level. In the cockpit, the noise is almost entirely aerodynamic; standing behind the pilot and about six

LANDING gear well detail is shown above. Detail of the wing panel joint is in photo below.



FUSELAGE center section below is made in Toulouse. Frames are made in these fixtures, off main production line. Half-frame (right) is part of structure over wing center section.

AVRO ARROW



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feet away, I could hear his normal conversation with the copilot, although both men were facing forward.

Inside the cabin, the observer's impression is that here is the world's first quiet airplane. There is a noise level, but it is low and in an unobjectionable frequency range. Furthermore, it is unaccompanied by vibration except for a small portion of the cabin right over the wing box, where high-frequency aerodynamic noise from the wing is transmitted into the fuselage structure.

Noise increases toward the rear of the fuselage; but in any seat you can use normal conversational levels and be understood by your seat companion and probably overheard by the passengers across the aisle.

Noise level is highest in the toilets at the aft end of the fuselage and in the compartment behind them not normally used by passengers.

Single-Engine Check

We reached 35,000 ft. and Nadot trimmed the Caravelle straight and level at 235 kt. IAS. With the outside air temperature at −54C, the corresponding flight Mach number was 0.68.

Nadot cut the port engine; in the cockpit the first indication was the change in engine rpm. on one instrument. In the cabin there was some reduction in the low noise level. With the port engine windmilling at 1,800 rpm., the indicated airspeed was 212 kt., and the Mach number was about 0.6.

Relighting and single-engine operation was normal, but Nadot wasn't satisfied with the engine controls. They had not been well-matched somewhere along the line, with the result that comparable throttle positions produced a wide variation in rpm. and thrust. This is not serious but is definitely an inconvenience to a pilot.

We headed back to St. Martin and started a normal procedure letdown. About halfway down, Nadot opened the air brakes; the deceleration was immediately obvious, but not uncomfortable. There was rumbling noise from the turbulence behind the perforated brakes. The fuselage angle was less than during the normal final approach of a Convair 440 Metropolitan.

We touched down and rolled for about 4,500 ft. on the wet runway with normal use of brakes and no brake chute. Taxiing back to the apron, and normal engine shutdown completed the flight.

First four Caravelles built were prototypes, either for flight or ground tests:

• **Caravelle F-BHHH,** the first prototype, made its first flight May 25, 1955, and completed its official test program for the company and the French government by April 30, 1956. During these tests, it flew 411 hr. In June that year it was turned over to Air France

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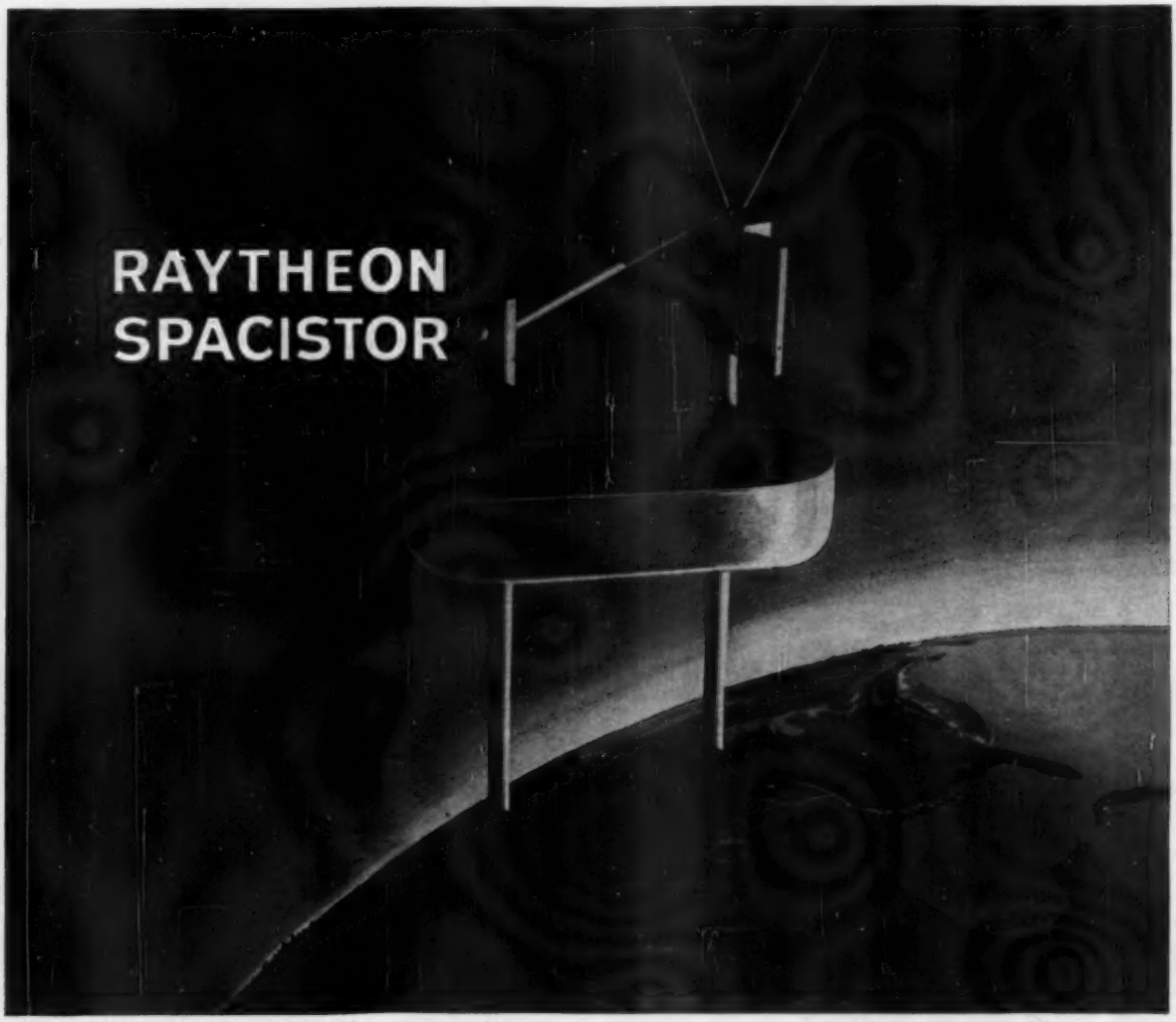

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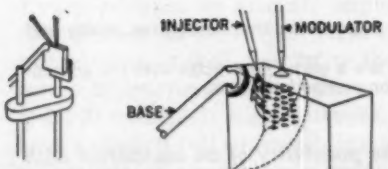

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The Spacistor—announced in 1957 by Raytheon scientists—is a brand new concept in electronics. It combines the amplifying power of the vacuum tube with the small size, ruggedness and low power requirements of the transistor.

Now in the laboratory stage, this remarkable device gives promise of still smaller, lighter, tougher and more powerful commercial and military electronic equipment—from portable radios to missiles.

First vacuum tubes, then transistors, now the Spacistor—Raytheon has pioneered in all three. This new device typifies creative engineering at Raytheon—the constant exploration of the frontiers of electronics.

RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY, Waltham, Mass.

with a total of 431 hr. on the plane. The French airline kept the plane in operational use until November, using it for cargo runs to North Africa, averaging 109 flight hours per month and putting on a total of 621 hr. for an over-all airplane time of 1,052 hr. In one day during the tests, the plane made round trip flights from Paris to Casablanca and Paris to Algiers, plus a local flight around Casablanca, for a total of 12-hr. and 13-min. utilization during the 24-hr. period. It also flew Paris-Casablanca-Paris on a 2,030 naut. mi. nonstop trip in six hr., seven min. for an average airspeed of 332 kt.

• **Caravelle F-BHHI**, the second prototype, made its first flight on May 6, 1956. Since then it has logged more than 350 test flights and more than 600 hr. time.

• **Caravelle third prototype** will never fly, but will instead be "flown" in fatigue tests in a water tank. Scheduled to begin at the end of this month in the water tank at EAT, the Caravelle tests will put an equivalent of 30,000 flying hr. on the plane. Loads will be applied by wing-leading-edge jacks for combined torsion and bending, while the fuselage is being cycled through its pressurization and de-pressurization periods. Fin torsion loads will also be fed into the tests. Cycling will be done during the 16-hr. off-shift periods, and during the eight-hr. working day, teams of inspectors and skin divers will check the fuselage. During each simulated two-hr. flight, the wing will get one 20 fps. gust, one 15 fps. gust and a dozen 10 fps. gusts.

• **Caravelle fourth prototype** is a static test airframe, scheduled to start its testing in June.

First production Caravelle for Air France has been rolled out and will be followed shortly by the second production, scheduled to be the first for SAS. Assignment of aircraft will alternate in the first 12 production Caravelles.

Dassault Mirage IIIA Designed for Mach 1.8

Paris—First Dassault Mirage IIIA, military version of Mirage III, has been assembled as interceptor aircraft in Mach 1.8 range.

Pre-series Mirage IIIA is equipped with Snecma Atar 9 turbojet engine producing 13,200 lb. thrust, plus a SEPR rocket engine of 3,300 lb. thrust. French air force has ordered 100, probably will order an additional 200.

Snecma also has fitted Atar 9 turbojet into Dassault Super-Mystere for flying testbed purposes. Aircraft normally is powered by Atar 101G engine of 9,680 lb. thrust. First French air force squadrons are expected to begin operations this summer. FAF has ordered 260 Mysteres.

proposed new issue

500,000 SHARES

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CAPITAL STOCK

(par value $1)

offering price $10 per share

(in single transactions involving less than $10,000)

objectives:

The Fund's investments will be concentrated principally in the common stocks of companies engaged in missiles-jets and automation. The Fund will emphasize possible long-term growth in its selection of securities in these fields.

These shares will be offered to the public commencing on or about June 17, 1958 through a group of underwriters headed by the undersigned.

A registration statement relating to these securities has been filed with the Securities and Exchange Commission but has not yet become effective. These securities may not be sold nor may offers to buy be accepted prior to the time the registration statement becomes effective. This advertisement shall not constitute an offer to sell or the solicitation of an offer to buy nor shall there be any sale of these securities in any State in which such offer, solicitation or sale would be unlawful prior to registration or qualification under the securities laws of any such State.

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A copy of the Preliminary Prospectus may be obtained from your local broker or dealer or by writing the undersigned.

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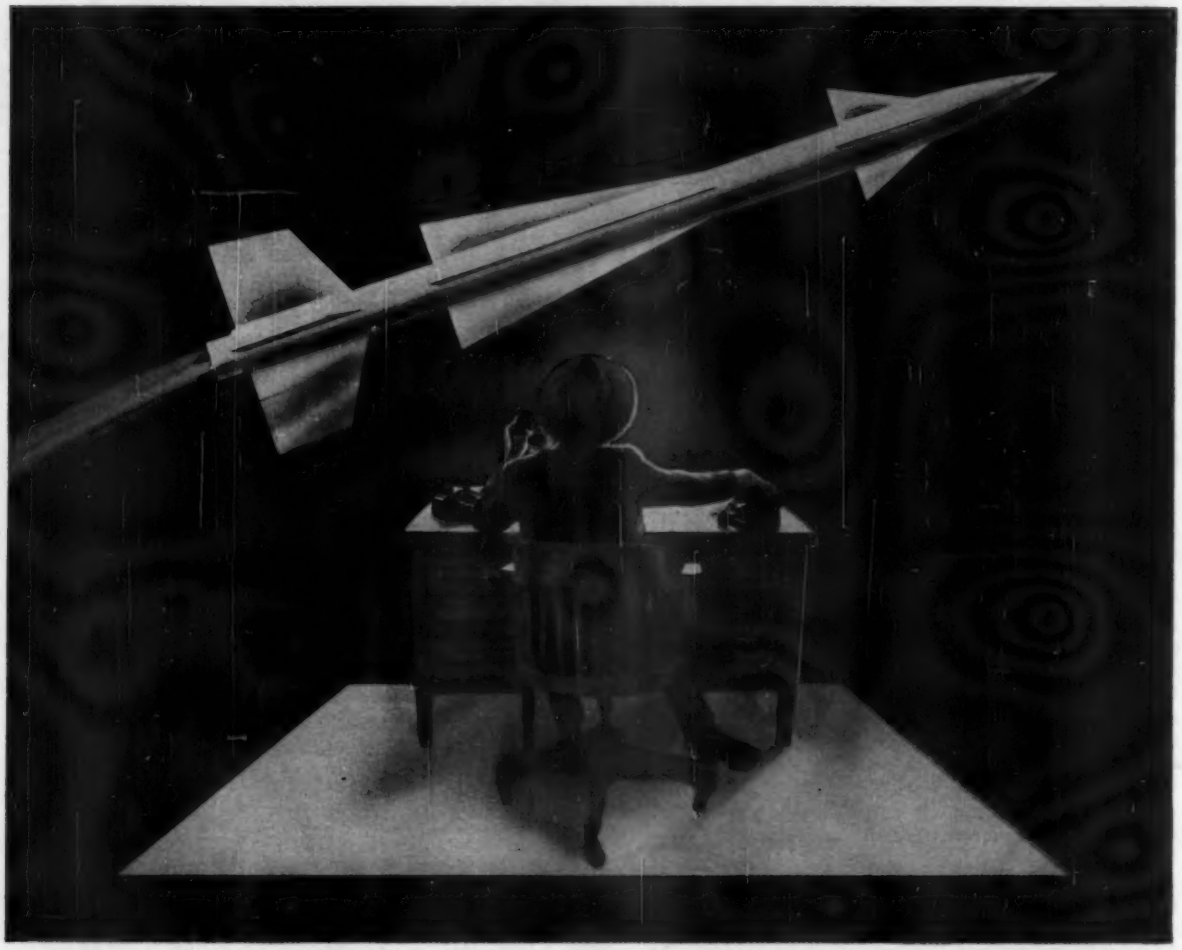

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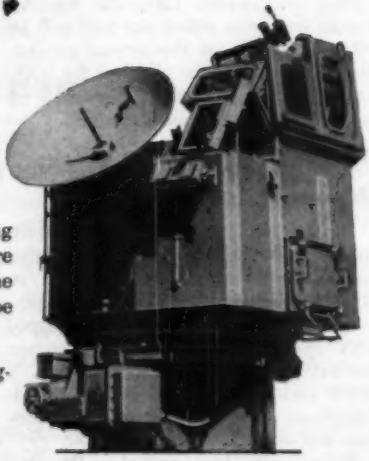

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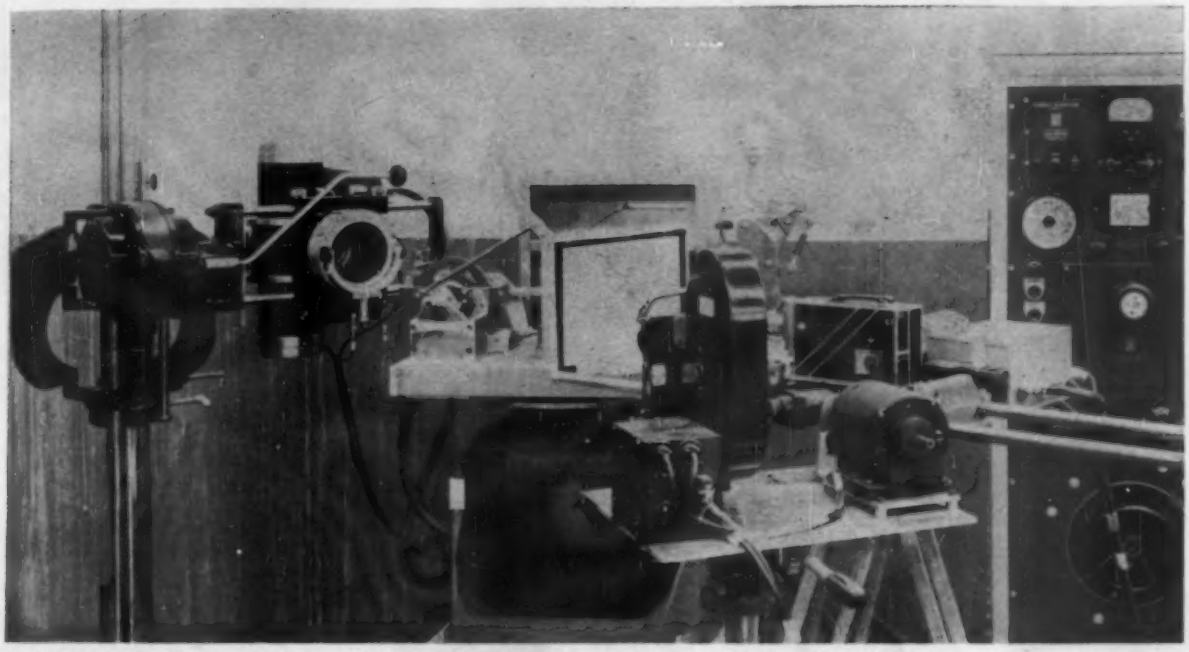


CINE-RADIOGRAPHY, new X-ray movie technique, reveals basic cause of malfunction in avionic, hydraulic, pneumatic or mechanical devices and equipment. Technique enables engineers to see what is taking place inside when device is subjected to adverse environment.

X-Ray Movies Record Equipment Failures

By Philip J. Klass

Cine-radiography, new technique which employs combination of X-rays and motion pictures, makes it possible to probe inner workings of avionic, hydraulic, pneumatic or mechanical devices and equipments while in operation to ferret out basic causes of malfunction and unreliability.

Device or equipment is exposed to X-rays while in operation, under vibration or shock if desired, and the X-ray fluorescent screen is photographed by motion picture camera operating up to several hundred frames per second. Resultant movie can then be projected at normal speeds over and over again while engineers analyze what is taking place inside the device or equipment walls or casing.

Detective Work

Here are two examples of cine-radiography detective work in finding previously hidden and inexplainable causes of malfunction:

• **Encapsulated servo amplifier,** employing two relays in output stage, performed erratically when subjected to random acoustical noise. Individual components, including relays, were tested individually under same noise environment and performed satisfactorily. When complete amplifier was examined by cine-radiography under noise environment, it was quickly apparent that there was mechanical coupling for the noise between two relays as result of compliance of the encapsulating material which separated them.

• **Hydraulic servo valve** for missile showed erratic operation when subjected to full pressure. Engineers knew that there were microscopic size particles in the hydraulic fluid, but when valve was disassembled following a malfunction there was no evidence of build-up of contaminating material. Cine-radiography revealed that a contaminate build-up actually was taking place, which caused change in flow pattern that washed away the build-up. This action, repeating at a high cyclic rate, proved to be cause of malfunction. With this knowledge, engineers modified flow pattern to prevent contaminate build-up.

Rototest Laboratories, Lynwood, Calif., is pioneering the cine-radiography technique. So far as is known, Rototest is only company in the country currently equipped for cine-radiography, according to Joseph Davidson, president. However, several manufacturers are considering installation of cine-radiography facilities, Davidson indicates.

Use of X-rays for static examination or photographs of such devices as vacuum tubes is not new, having been used by tube and some missile manufacturers for several years.

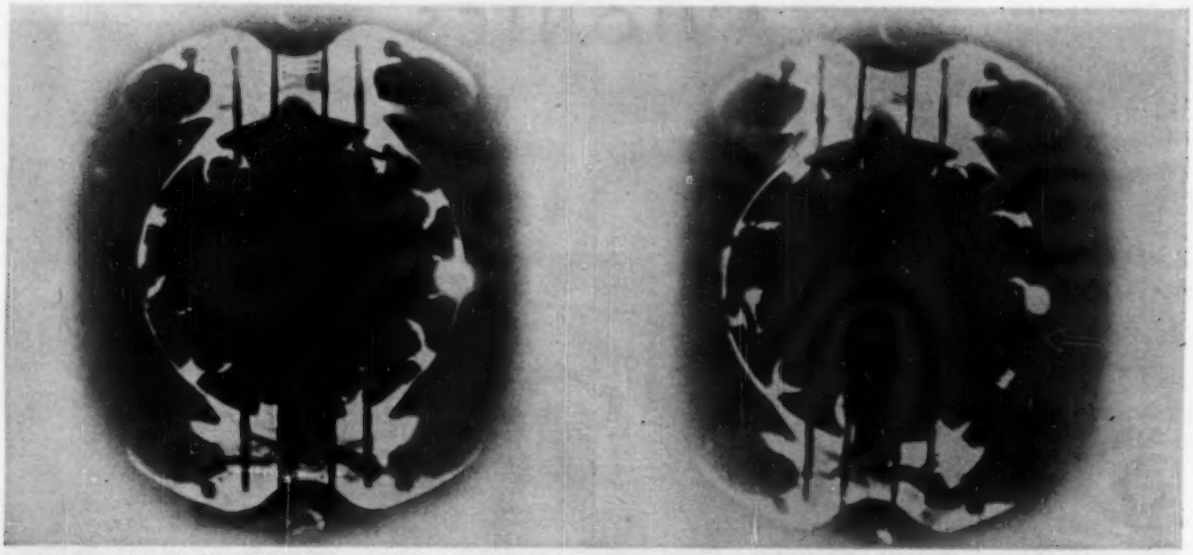
How It Operates

Device to be analyzed by cine-radiography is placed between X-ray machine and fluorescent screen so that a sharp focus is obtained. Motion picture camera is set up on opposite side of screen, its shutter precisely synchronized with X-ray machine pulses to obtain maximum screen brightness for each frame.

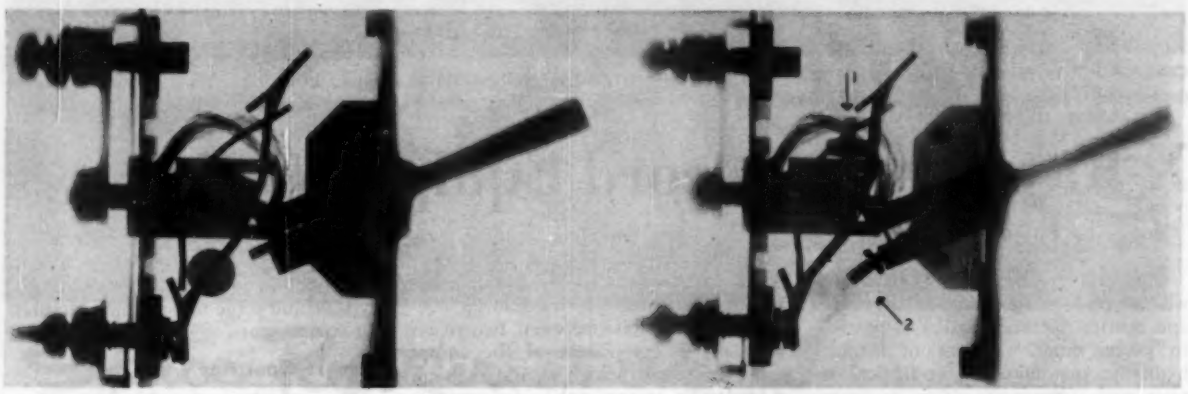
Size of objects which can be handled depends upon power of X-ray machine, thickness of material which must be penetrated and the desired movie frame speed.

A 1,000,000-v X-ray machine, for example, can accommodate a specimen two square feet in area, with frame speed of 120 per second. Smaller components can be photographed at higher frame speeds, using lower X-ray voltages, according to Rototest's Dr. Irving Rehman.

At present Rototest can work up to frame speeds of 500 per second, but is developing new techniques and hopes to acquire equipment which will enable it to operate up to speeds of 5,000 frames per second, for analysis of ex-



X-RAY of motor operating without external vibration (top left) shows normal clearance between rotor and stator. When external vibration is applied (right) X-ray reveals eccentricity of rotor position and stator contact. Below, air borne switch is in normal position (left). After vibration (right) roller contact is dislodged (arrow No. 1) and roller holding mounting (arrow No. 2) is about to drop to bottom of switch case.



tremely high speed motion (300,000 rpm.) and vibration.

Value of cine-radiography, particularly for extremely small devices or elements under analysis, can be greatly enhanced by interposing closed-circuit television between the X-ray fluorescent screen and the movie camera, according to A. J. Romano, Rototest general manager. With closed-circuit TV, any portion of the image on the fluorescent screen can be blown up in size when displayed on TV monitor screen.

Preliminary Studies

Closed-circuit TV also can be used for preliminary studies of devices under X-ray analysis in order to determine which elements should be photographed and under what environmental conditions.

Saving in movie film should pay for cost of closed circuit TV equipment in short time, Romano believes.

Closed-circuit TV also is important addition when working with high voltage machines where radiation presents hazard to human operators working too close to fluorescent screen. Use of remote TV monitor for viewing speeds up process of adjusting sample position to obtain desired view and sharp focus.

Special Techniques

Rototest has devised number of special techniques for further enhancing the usefulness of cine-radiography, when required, including:

- **Stereo (3-D) cine-radiography,** where depth perception can aid analysis, is achieved by making two movie films. One is made with X-ray machine illuminating specimen from one position, then illumination is shifted slightly and a second film is run as test is repeated.
- **Stroboscopic cine-radiography,** using conventional stroboscope, permits synchronization of camera shutter speed and X-ray pulses to produce "stopping" of high-speed motion of elements of device under observation. Technique can be employed, for example, in study of high-speed rotary components like motors.

In addition to trouble-shooting faulty designs, cine-radiography also can pay off in factory for quality control and inspection of outgoing production, according to Davidson.

It also should be a time-saver for engineers during initial design phases, particularly for mechanical, hydraulic and pneumatic devices where previously engineers could only speculate on internal operation based on external device performance.

Financial Support

Rototest Laboratories hopes to obtain financial support from one or more military services to expand its present cine-radiography techniques for industry use. This will include developing techniques for handling larger, more dense equipments and devices, as well as exploring new applications for the technique. Company's address is 2803 Los Flores Blvd., Lynwood, Calif.

T/I transistorized 'peeping drones' see better...fly farther

Transistorized radar... and other Texas Instruments "electronic eyes" can peg the shape, location, motion, heat, and magnetic character of "targets of opportunity"... *relaying this vital data for action in those brief moments that the opportunity exists!* In manned or unmanned reconnaissance aircraft, TI's light, tough and compact electronics save fuel, space and weight while trimming maintenance and logistic problems.

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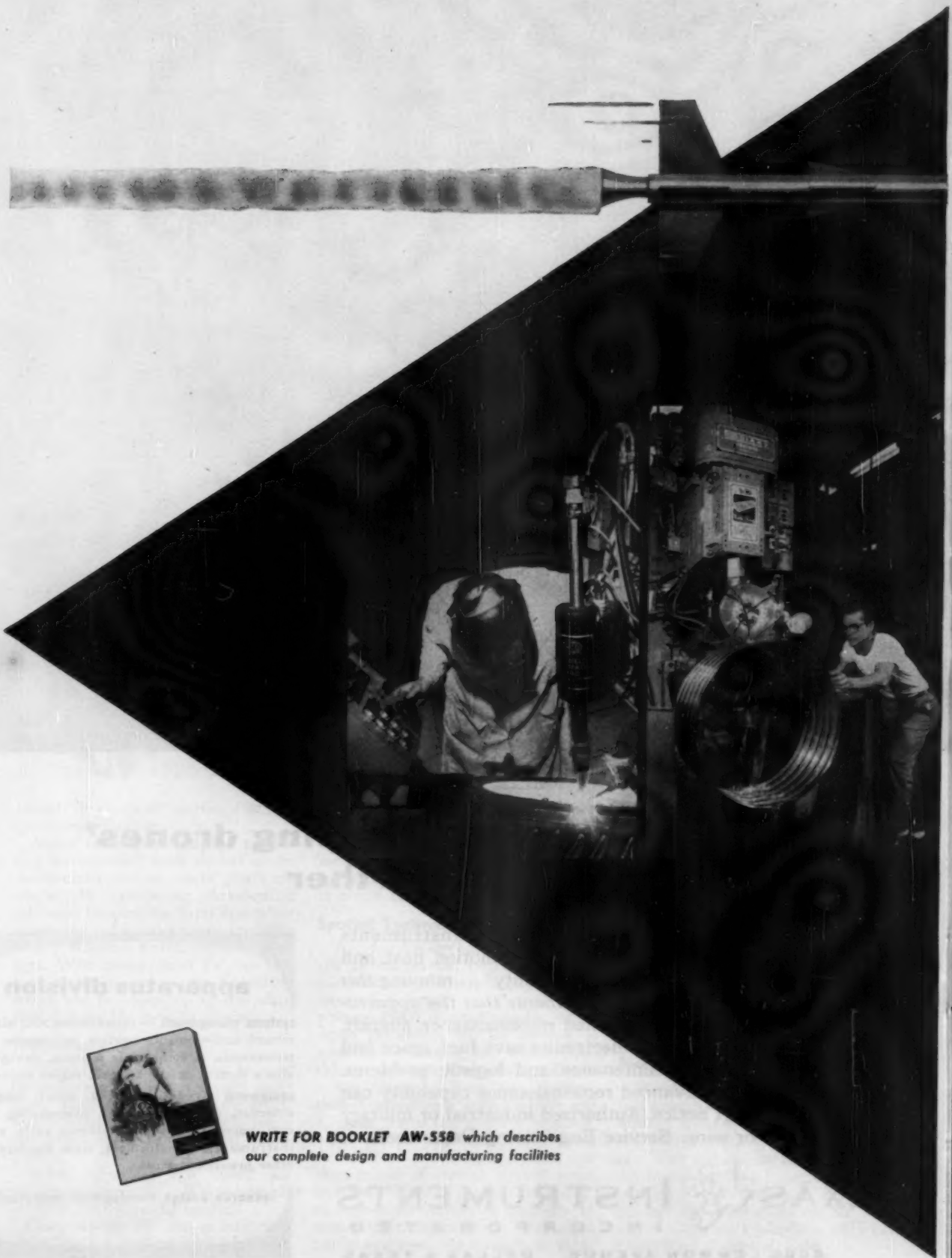
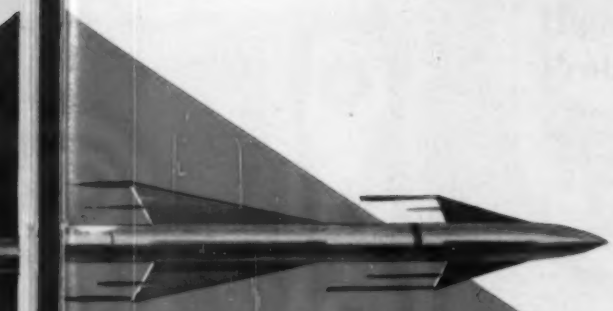


***WRITE FOR BOOKLET AW-558** which describes our complete design and manufacturing facilities*



WELDMENTS FOR MISSILES... ANY SIZE, ANY ALLOY... FROM THE JET DIVISION

Some weldments are heavy pieces of beefed-up hardware to help put an ordnance-type missile into the air and on target . . .

Other weldments are created from thin alloy sheets to keep an aircraft-type missile within its weight limitation without sacrificing strength . . .

The Jet Division produces both types . . . the shapes rolled from plate and the shapes stamped out of sheet. They can be made from either alloy or stainless steel, as well as titanium, zirconium, and other missile-age metals.

Welding techniques include inert atmosphere, shielded arc, and conventional methods. Stress-relieving and heat-treatment furnaces give Jet Division weldments the ultimate in strength.

On your missile project, our design and production ability augment your own manufacturing and design facilities. A sales engineer is available to discuss your requirements at your early convenience.

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The higher you are, the further you can see. The same applies to radar. The modern crow's nest for radar is the Grumman WF-2 Tracer. With electronic eyes set in an aerodynamic saucer, the Tracer can track distant aircraft and high speed weapons and give early warning to its task force.

The WF-2 Tracer is another example of Grumman helping to make the United States Navy the most effective police force in cases of international delinquency, plus a deterrent to all-out aggression.

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High-Level Radiation Probed by Scientists

Washington—U. S. scientists are moving rapidly to learn more about the nature and source of high intensity radiation discovered at altitudes above 600 mi. from data telemetered back by Explorer I and III satellites (AW May 5, p. 39.)

• **Apparatus capable of determining** whether radiation comes from protons or from X-ray radiation resulting from electron bombardment of satellite shell has already been constructed and probably will be flown in an early satellite.

• **Launching of satellite into** high-latitude (near-polar) orbit may be attempted from USAF Missile Test Center, Cape Canaveral, Fla., before the end of the year to determine whether intense radiation is found at lower altitudes near the poles, as the theory now suggests.

Intensity of radiation encountered in two U. S. satellites, which would give a satellite passenger a maximum safe weekly dosage in only two hours, probably can be reduced by 90% with approximately one millimeter of lead shielding, according to Dr. James Van Allen, International Geophysical Year panel member who reported the new findings to the National Academy of Sciences.

Present theory on the intense radiation is that it stems from a layer of ionized gas, probably hydrogen, which is periodically emitted from the sun during periods of solar flare-up. Electrons and protons in the gas plasma appear to have extremely high energy levels in vicinity of the earth—around 100,000 electron volts, according to Dr. Van Allen.

Earth's magnetic field is believed to act as a shield which prevents most electrons and protons from penetrating lower altitudes. Electrons are believed to spiral back and forth along the earth's lines of magnetic force above 600 mi. altitude, coming down to lower altitudes only near the poles where magnetic lines converge. Radiation is believed responsible for the aurora phenomenon encountered at high latitudes.

If the high intensity radiation is found at lower altitudes near the poles, it would support this theory. Present U. S. satellite orbits are limited to about 34 deg. on either side of the equator.

Some of the electrons and protons gradually seep down below the 600 mi. altitude at lower latitudes, scientists believe, but these quickly dissipate their energy in the more dense atmosphere, hence are not detected at lower altitudes.

Beattie-Coleman built 100 g's into the MPR-13 Programer

Resistance to high shock loads is just one of the amazing pluses of the Beattie-Coleman MPR-13 punched Mylar tape Programer. The MPR-13 is the accepted standard for multi-channel programming because of its compatibility with most missile guidance systems . . . and performs with an accuracy of one part in 50,000 under these high "g" loads! Programs can be initiated or altered in a few minutes with millisecond precision for either repeat cycling or random operations.

The rugged Beattie-Coleman MPR-13 Programer weighs 3 lbs. 10 ounces, is 2"x3"x6". More information is available on request.

BEATTIE-COLEMAN inc.

1000 N. Olive St., Anaheim, California

GIANNINI FREE GYRO

precision helmsman in the

TALOS

PHOTO COURTESY BENDIX AVIATION, MISSILE DIVISION

GIANNINI'S MODEL 3416 FREE GYROS MAN THE HELM IN THE NAVY'S TALOS. Mid-course guidance of the TALOS missile is achieved by riding a radar beam to the vicinity of the target. Immediately after launching, aerodynamic considerations require the missile to fly a *straight and narrow* path, maintaining constant attitude. Giannini Two-Axis Free Gyros have been piped aboard the TALOS to hold it "steady as she goes!"

Remotely Energized Electrical Cage-Uncage System

Low Drift during High Vibration

Unrestricted 360° Travel of Both Gimbals

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Giannini measures & controls:

ω	β	θ	ψ	τ	v	ϕ
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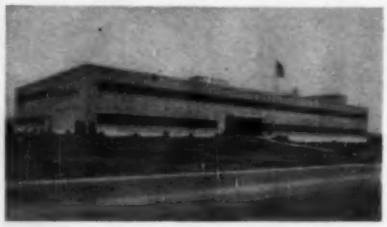
Expansions, Changes In Avionics Industry

Westinghouse Electric Corp. has established a microwave research and development center in Ithaca, N. Y. Facility, part of company's electronic tube division, will be headed by Ernest C. Okress.

Other recently announced changes, expansions, new facilities in the avionics field include:

• **Sylvania Electric Products, Inc.,** has officially opened 85,000 sq. ft. Amherst Engineering Laboratory, near Buffalo, N. Y., which is engaged in research, development and production of countermeasures, radar, navigation, communications and other avionic systems. New facility employs about 500 persons, half of them engineers and scientists.

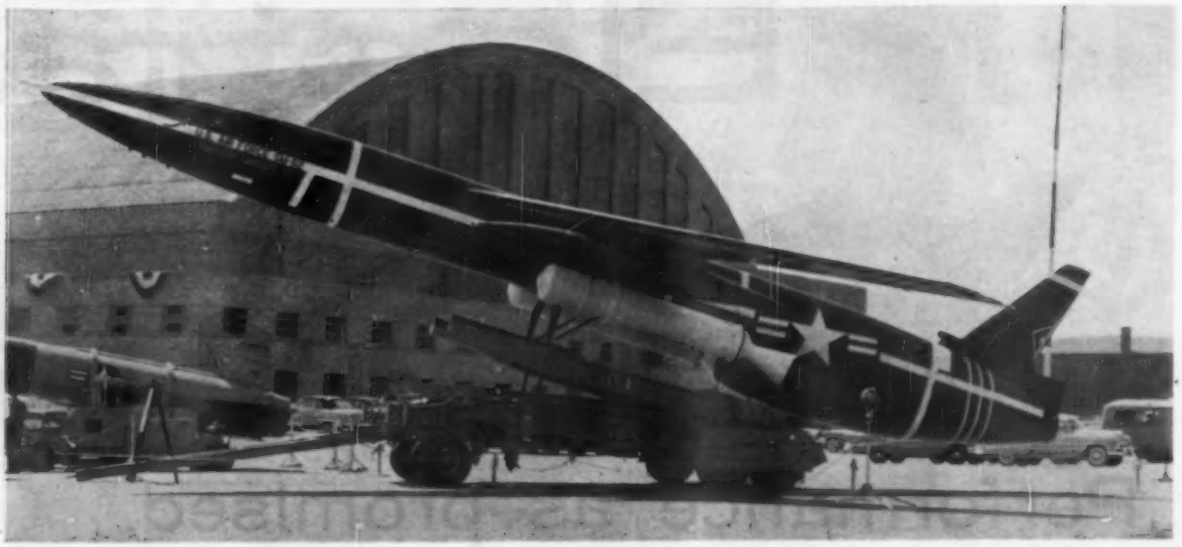


• **Gulton Industries, Inc.,** has formed Digital Devices Department which will apply semiconductor techniques to data acquisition and reduction in analog and digital systems. Department is assigned to CG Electronics Corp., Albuquerque, N. M., wholly owned Gulton subsidiary. Harry B. Barling heads department.

• **Hewlett-Packard Co.,** Palo Alto, Calif., has set up four new product divisions in reorganization of its research and development department. Electronic counter division is headed by Alan S. Bagley; Norman B. Schrock heads oscilloscope division; W. Bruce Wholey heads microwave and signal generator division, and John M. Cage heads audio and video equipment division. Company also created standards laboratory, industrial design and advanced development sections.

• **Amphenol Electronics Corp.,** Chicago, has formed new Cable & Wire Division to be headed by James E. Sullivan. Headquarters are located at Amphenol's Plant No. 4, 63rd and Harlem.

• **International Telephone & Telegraph Corp.** has consolidated all its U. S. research and development activities into a division to be known as IT&T Laboratories. Included in the consolidation are Federal Telecommunication Laboratories, Nutley, N. J., Farnsworth Electronics Co. research and development facilities, Ft. Wayne, Ind., and similar facilities of Kellogg Switchboard & Supply Co., Chicago. New division is headed by Henri Busignies, president of FTL for past two years.



MOBILE launcher for USAF's Snark is 16-wheel launcher made by Nuclear Products-Evco Division of ACF Industries, Inc.

Missile Handling Becomes Big Business

New York—Ground handling and support equipment for missiles is expanding so rapidly that some ground handling systems have outstripped the missiles they support in terms of dollar expenditure and job assignment.

In the past, missile handling systems were considered a necessary nuisance. Now industry recognizes that the systems are a vital part of the entire missile program. Sign of this new respectability is the fact that the American Ordnance Assn. has formed a missile handling group within the past year.

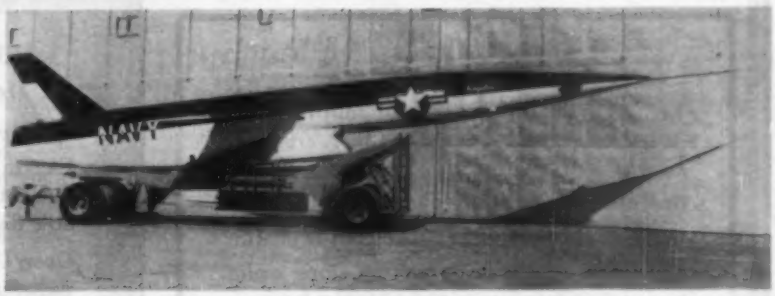
Government officials gave AVIATION WEEK yardsticks for the relative expenditures allocated for ground support handling equipment and the missiles they support.

First supplemental 1958 appropriation for missile ground support equipment for all the armed services is $1.4-billion; for missiles, $30 million.

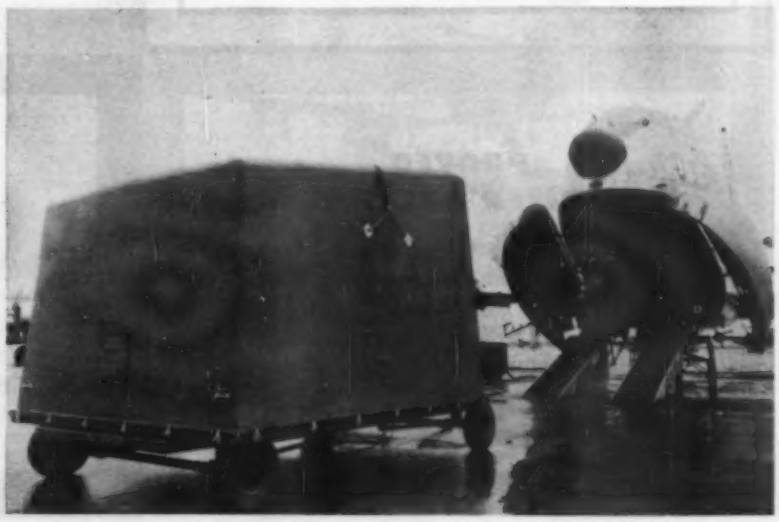
$900 Million for USAF

Of the $1.4 billion total, Air Force's total is $900 million. Here is how USAF plans to spend its share:

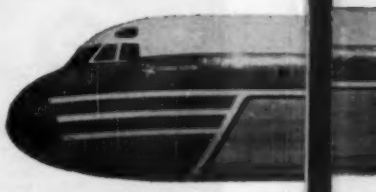
- **$500,000,000** for facilities and construction of ground support equipment and IRBM/ICBM sites.
- **$190,000,000** for acceleration of ICBM ground support program.
- **$170,000,000** for electronic ground support equipment.
- **$20,000,000** for research and development programs for ground support equipment.
- **$20,000,000** for classified ground



REGULUS II cruise missile (above) is mounted on Freuhauf Trailer Co. mobile launcher. Below, Freuhauf transtainer for Titan intercontinental ballistic missile is loaded into C-124.



Electra



Performance as promised

All Electra Guarantees met—

Proved Short Field Capability

Flight Tests show the Electra landing descent and stopping characteristics will more than meet guarantees. In fact, the Electra is consistently making stops using less than 2,500 feet of runway.

Meets Passenger Comfort Demands

"Belt-Free" Flight—On a typical 400-mile trip, Electra spends only about 15 minutes in climb, descent and taxi...55 minutes in level, comfortable flight.

Over/Under Weather Flexibility—Electra assures passenger comfort by being able to take off and fly at any altitude from 5,000 feet to 25,000 feet with less than 1% variation in speed.

PROVED POWER PACKAGE

Electra's 4 General Motors Allison Prop-Jet Engines will have accumulated a combined total of 350,000 ground and flight test hours before entering airline service this fall...one of the most comprehensive engine-package test programs ever undertaken.

DESIGNED-IN LOW MAINTENANCE

Electra has major components grouped into "man-height" central service areas. Uses many interchangeable units with quick plug-in connections—reducing en route delays, down time and costs.

Flight

or exceeded in Flight Tests

ASSURED LOW COST OPERATION

Realistic Load Factors—Even on "thin traffic routes," Electra's 88-seat capacity offers an opportunity for profit. Assuming a 50% break-even figure, the Electra will need only 44 passengers, contrasted with the 60 or more needed on the turbojet's 120-seat capacity.

Low Cost Power—Electra's efficient prop-jet engines give more horsepower for every fuel dollar.

Low Fuel Consumption—On a typical 300-mile flight Electra can fly at any altitude from 5,000 to 25,000 feet with operating costs varying only 2%.

Complete After Sale Support

Lockheed's new "Electra/Flight" advertising and promotion theme is now appearing in business magazines, soon begins in the pages of national and international mass media.

Electra purchasers get *complete* in-service operational support—including outstanding spare parts service, world-wide field service, ground and flight training support, special introduction teams and other valuable assistance.

Purchased by

Aeronaves de Mexico • American Airlines
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PSA—Pacific Southwest Airlines
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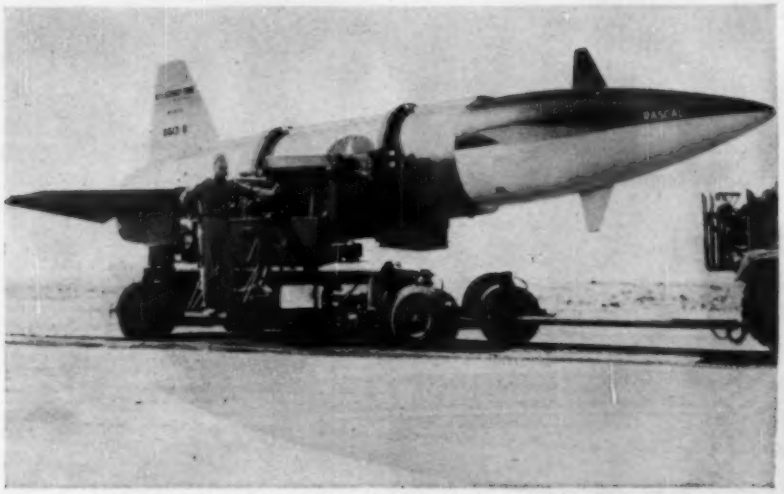
LOCKHEED ELECTRA

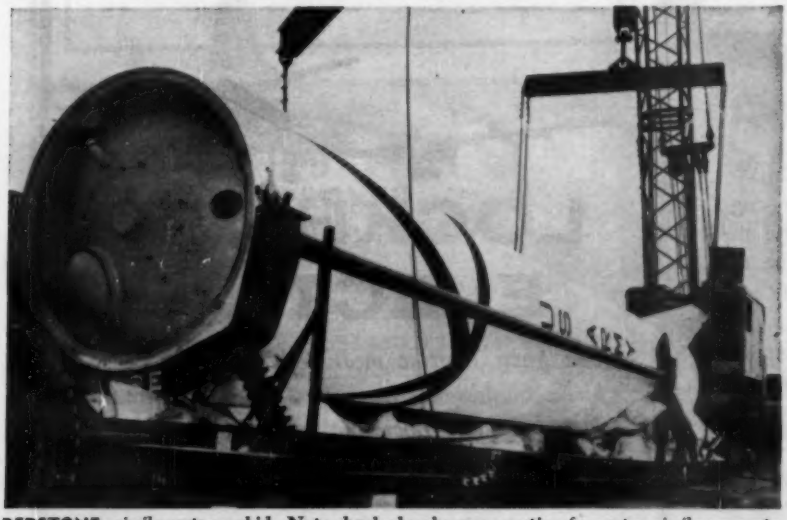
The finest short-to-medium haul turbine-age airliner—designed to assure you maximum return on every operating dollar.

LOCKHEED AIRCRAFT COMPANY, BURBANK, CALIFORNIA



BELL Rascal is carried on transporter-lift vehicle made by Lull Manufacturing C .

LIQUID oxygen tank, loaded into Douglas C-133, is manufactured by the Cambridge Corp.



REDSTONE missile rests on skid. Note shock absorbers connecting frame to missile supports.

support equipment projects.

Speed with which ground support equipment dollar expenditures is growing compared with similar expenditures for missiles is underlined by these comparative fiscal allocations:

- **$323.8-million** was allocated for the entire missile ground support equipment program of 1957.
- **$503.5-million** is programmed for the same purpose for 1958, an increase of $179.7-million in one year.
- **$880-million** was allocated for missiles alone in 1957.
- **$881-million** is programmed for missiles alone in 1958, an increase of only $1-million.

More Job Assignments

Job assignments—or personnel—for missile ground support equipment often exceeds those for the missile itself, Irving J. Minett told AVIATION WEEK. Minett, who has been general manager of Chrysler Corp.'s Defense Operations Division since late 1956, recently was appointed as group executive in charge of Chrysler's newly-formed Missile Division. He also will continue to direct the Defense Operations Division.

Ground support equipment requires more job assignments, Minett says, because missile ground check-out gear incorporates almost as much electronic, pneumatic, and hydraulic equipment as the missile itself. On top of the ground duplication of almost all airborne components and systems, come such items exclusive to missile ground support as transporters, fuelers, erectors to place missiles on the launching platforms, launching platforms, and a vast array of safety gear.

New missile division will be responsible for Chrysler's participation in development, engineering and production of the Redstone and Jupiter programs under a $52 million contract awarded last January.

Varied group of companies went into the business of making ground support equipment as the market began to expand.

Some are well-established aircraft firms, such as North American Aviation Inc., which is making transtainers for the Martin Co.'s Titan intercontinental ballistic missile.

Others are long time major component suppliers to the aircraft industry, such as Goodyear Aircraft Corp., which is responsible for about 70% of the entire ground handling program for the TM-76A, Mace guided missile weapon system also being made by Martin.

Still others are relative newcomers to the aviation/missile business, such as Food Machinery and Chemical Corp. whose Ordnance Division makes the transporter-erector for Douglas'

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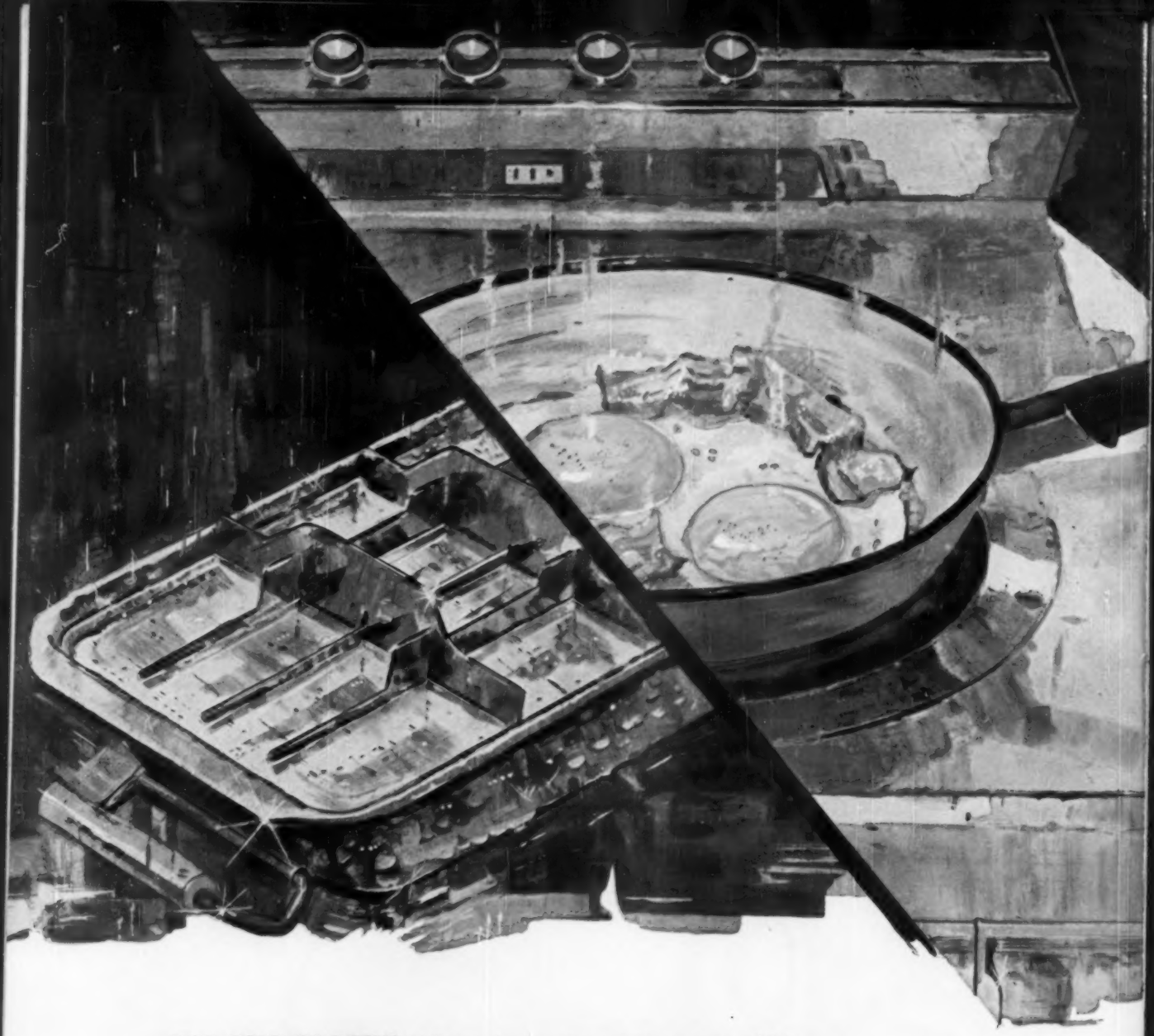

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Thor intermediate range ballistic missile. Company also makes a tracked missile handler for the Hawk ground-to-air missile.

Company Survey

AVIATION WEEK made a survey of 16 companies engaged in the manufacture of missile ground handling and support equipment. Here is a summary of this roundup (companies are listed alphabetically):

• **American Bosch Arma Corp.** is building ground electronic test equipment to check avionic components of the inertial guidance system it is making for Martin's Titan ICBM. Work is being done at a new plant the company recently opened in the Chicago area for the design, development and production of ground support and test units.

• **American Car & Foundry Co.** makes the transporter/lifter for Bell Aircraft Corp. Rascal air-to-surface missile. Vehicle was designed by Bell. ACF also makes the launcher for Boeing's Bomarc surface-to-air missile.

• **Baker Industrial Trucks Division,** Otis Elevator Co., produced Traveloaders for transporting and lifting the Corporal surface-to-surface missile made by Firestone Tire & Rubber Co. under contract to Jet Propulsion Laboratories, California Institute of Technology. Lull Manufacturing Co., a predecessor of Baker, made a similar vehicle for Bell's Rascal.

• **Cambridge Corp.** is making king-size thermos tanks to store liquid oxygen used to fuel Thor IRBM. Air-transportable (in Douglas C-133s) tanks are more than 50 ft. long, 8 ft. high and have a capacity of 13,500 gal.

• **Craig Systems, Inc.,** makes aluminum shock-mounted containers for Philco's Sidewinder air-to-air infrared-guided missiles, containers for fins and wings of Convair's Terrier surface-to-air missiles and Helicop-Hut (helicopter-transportable) mobile shelters which the company says are presently being programmed in operational versions for Air Force and Army missiles being fired at Cape Canaveral, Fla.

• **Food Machinery and Chemical** Corp. Ordnance Division is going into production of ground support equipment for Thor IRBM. Equipment includes transporter-erector vehicles, launch base from which missile is fired, and power-pack trailer containing hydraulic and electronic systems needed to actuate initial steps of the firing sequence.

Company makes a tracked transporting and handling vehicle for Raytheon's Hawk surface-to-air missile. Contract is to build launcher-erectors and power pack units for Boeing Bomarc interceptor missile at San Jose, Calif., plant.

• **Fruehauf Trailer Co.** Missile Products Division is making a variety of ground handling and transport equipment for such missiles as Martin's Titan ICBM, Chance Vought's Regulus II surface-to-surface missile, Chrysler's Redstone surface-to-surface missile and Douglas' Genie air-to-air nuclear warhead missile.

• **General Electric Co.** Missile and Ordnance Systems Department is building a shipboard automatic missile selection and launching system for Bendix Talos surface-to-air missile. This is the company's first contract for missile handling systems. Department also is equipping large vans with complex electronic checkout equipment to test nose cone systems the company is making for Atlas ICBM and Thor IRBM.

• **General Mills Inc.,** Mechanical Division is at present making missile ground support equipment under subcontract to AC Spark Plug for Martin's TM-76A Mace missile and for Cal Tech's Jet Propulsion Laboratory on Chrysler's Jupiter IRBM.

• **Goodyear Aircraft Corp.** is responsibile for some 70% of the entire ground handling program for Martin's TM-76A Mace ground-to-ground missile. This includes the Teracruzer missile transporter, physical ground support vehicles and equipment. Company also makes the missile handling trailer for Convair's Atlas ICBM which is used to transport the missile and support it

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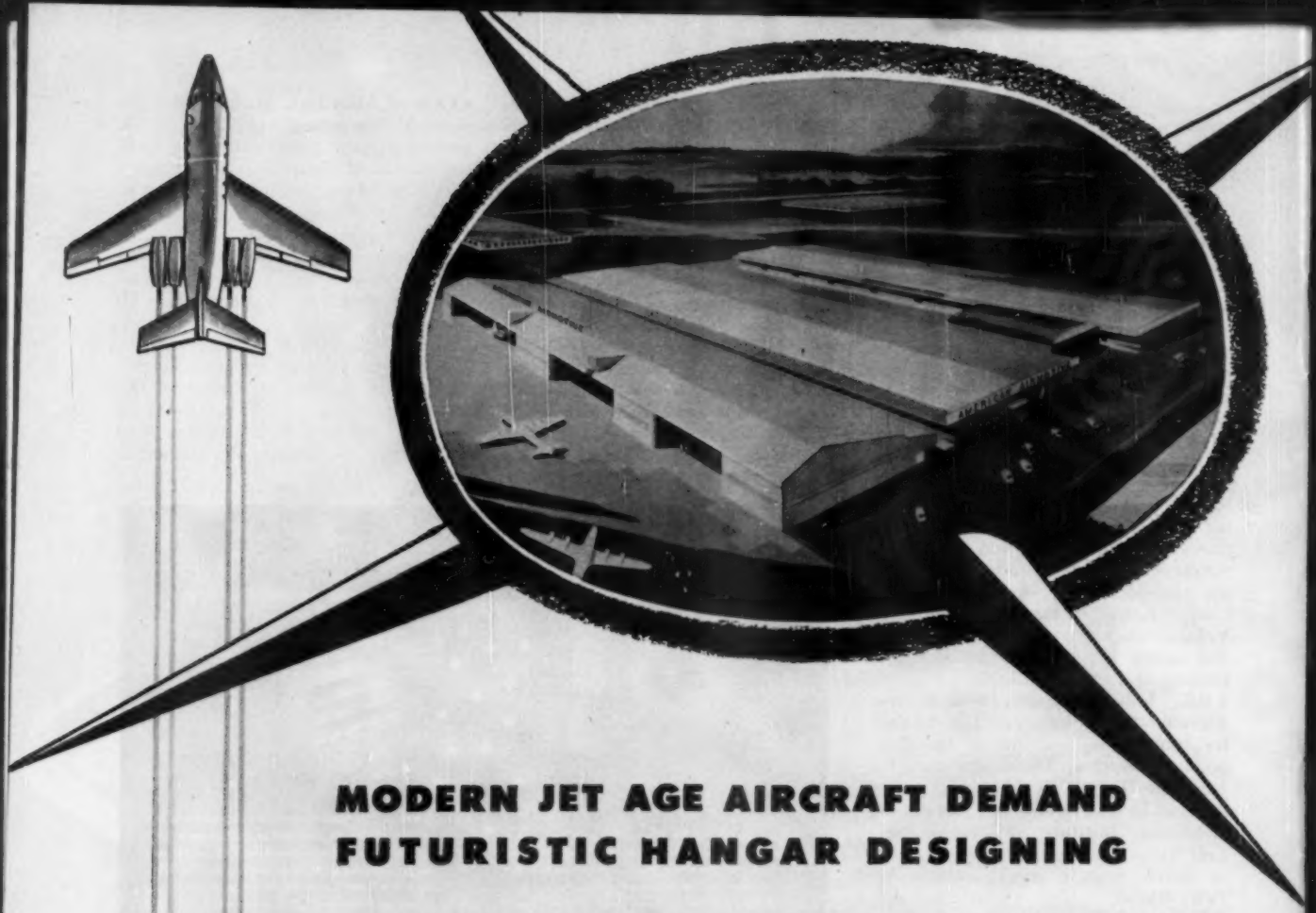

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This L. B. Smith hangar, International Airport, Miami, Fla., is 80′ x 360′ x 22′ with a 60′ x 360′ back shop and office section, with a 30′ x 360′ mezzanine.

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while it is being erected to the vertical, launching position.

• **Gramm Trailer Corp.** has made electronic checkout vans for Raytheon missiles and electronic equipment trailers for Chrysler missiles.

• **R. G. LeTourneau, Inc.,** built about 50 vehicles called Corporal Loaders for the U. S. and British Armies. Machine transports and erects the Jet Propulsion Laboratories' surface-to-surface missile. LeTourneau has designed equipment to handle commercial loads up to 150 tons which could be adapted to be used with ballistic missiles.

• **Loewy-Hydropress Division,** Baldwin-Lima-Hamilton Corp. built the test and launching pads for Vanguards at Cape Canaveral missile launching site. Division is now building nearby a Ship Motion Simulator for Navy's submarine-carried Polaris IRBM (AW Feb. 17, p. 53).

• **North American Aviation, Inc.,** is building transtainers to transport the first and second stages of Titan ICBM. (AW March 31, p. 24). Vehicles were designed by Martin and can be towed from either end.

• **Cleveland Pneumatic Tool Co.** designed transtainers for the same two Titan stages, but the contract was awarded to North American.

• **Sperry Gyroscope Co.,** division of Sperry Rand Corp., made the prototype transporter-erector for the Sergeant surface-to-surface missile. The Army missile is still under development by Cal Tech's Jet Propulsion Laboratory in cooperation with Sperry, which is the contractor for future production.

• **Trailmobile, Inc.** makes special composite steel-and-aluminum containers for Martin's Lacrosse surface-to-surface missile built for the Army. Container is made of a rigid frame encased in light gage steel. Missile itself is supported by a shock-mounted cradle.

• **U. S. Steel's** Western Steel Division makes complete launching and major ground handling segments for Nike Hercules guided missile. Major components include launching and transport rails and launcher-loaders. Division also manufactures spare parts under subcontract to Douglas Aircraft Co.

Large scale participation with which a subcontractor can participate in a weapon system program is illustrated by the manifold responsibilities held by Goodyear Aircraft Corp. on Martin's Mace missile. Here is what the company is handling:

• **Guidance system** which is Goodyear-developed Atran (Automatic Terrain Recognition and Navigation system).

• **Nose of the Mace's airframe.**

• **Testing concept** for all the missile's systems.

• **Ground support** equipment.

Atran guidance system is devel-

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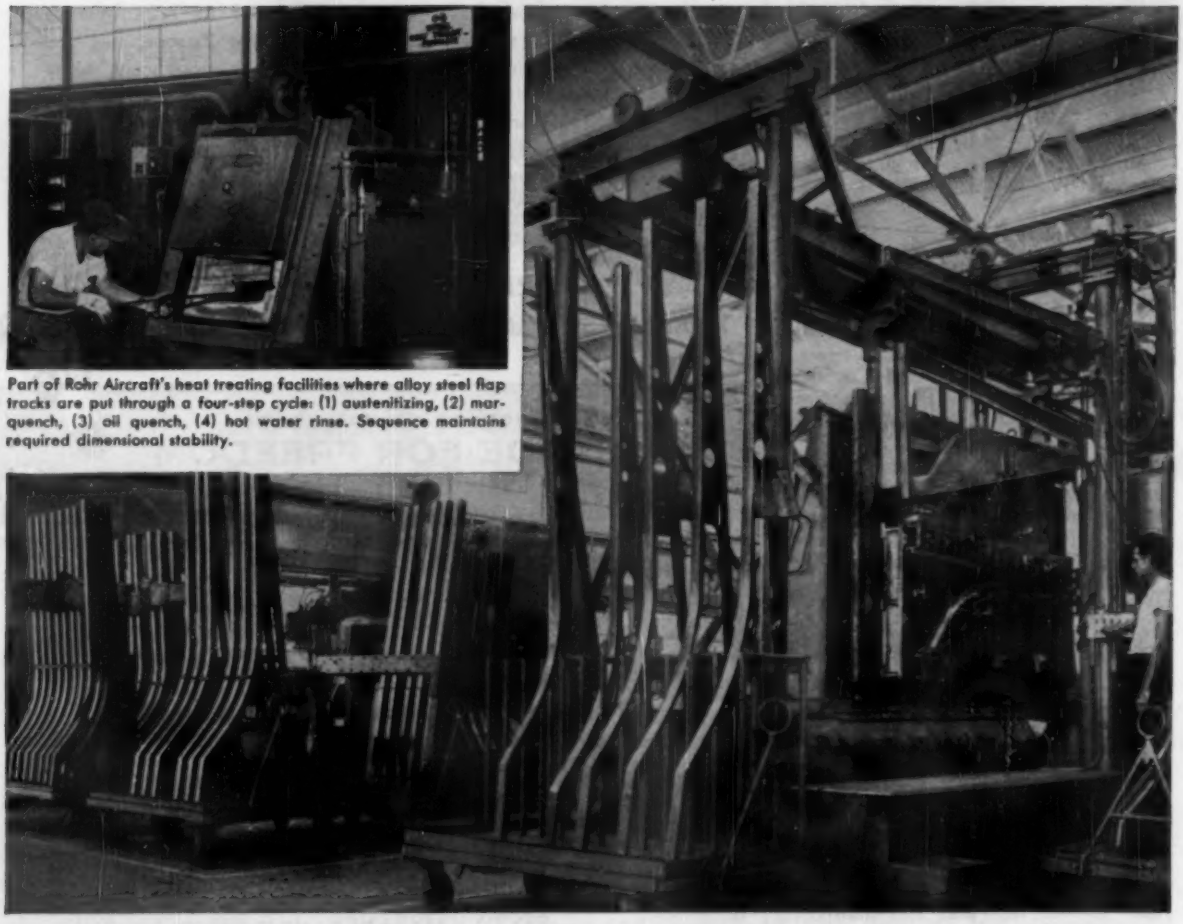

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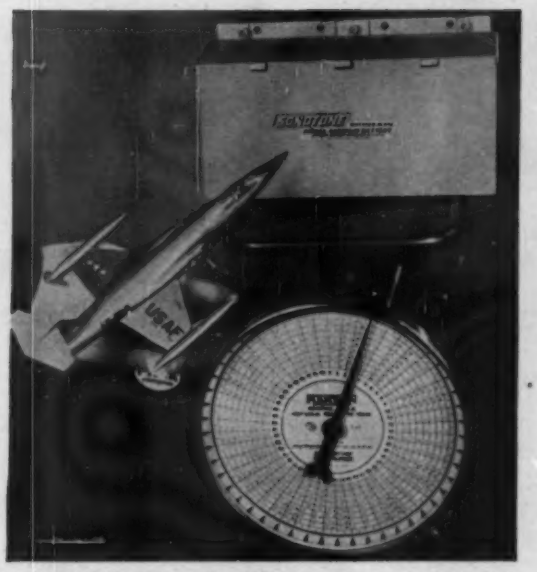

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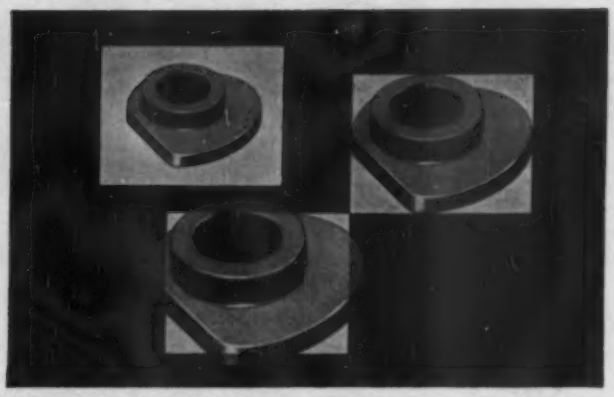

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oped to the point where it is able to follow a map to direct Mace to enemy targets. Formerly, Atran required an electronic "map" such as a tape or a film recording of the terrain which had previously been recorded from a radar set carried by reconnaissance aircraft. In operation, Atran continuously compares recorded map with terrain and automatically corrects for any deviations from desired track (AW Feb. 17, p. 23).

Goodyear engineers established this three-phase test program for Mace:

- **Component test,** accomplished at the factory which is a time-consuming, manual operation requiring high skill.
- **System test,** performed at the missile assembly area which is a faster, semi-manual operation requiring less skill. Test is used to isolate a faulty black box.
- **Missile test,** performed at the launching site is a quick, automatic operation requiring low skill.

Fewer Vehicles

Development of the Matador weapon system from the original TM-61A through the TM-61B to the TM-76A involved many changes. In the ground transport and support field, there was a two-phase modernization program.

First improvement involved reducing number of vehicles required by the system from 13 to four. However, vehicles used were still standard trucks.

When the TM-76A Mace came into being, the Air Force also wanted greater flexibility and better ground transportability. As a result, Goodyear established the specifications for the Teracruzer (AW Feb. 4, 1957, p. 96) all-terrain vehicle. It rides on eight very low pressure, barrel-like pillow tires which roll over almost any type of ground surface condition.

Teracruzer was engineered and built by Four Wheel Drive Auto Co. and its missile-carrying translauncher semi-trailer is being built by Fruehauf Trailer Co.

Teracruzer's dimensions were tailored to fit in a Lockheed C-130 or larger aircraft. Advantage of the vehicle is immediately apparent: with a gross weight of 8 tons, it has a payload of 8 tons. A standard 5 ton truck weighs 9 - 10 tons.

Once the basic Teracruzer design was established, Goodyear engineers designed a family of support vehicles around the Teracruzer concept.

Support family includes:

- **Storage pack** for such items as crane tools and spreader bars.
- **Fuel servicing pack,** including pumps, filters, hose, and reels.
- **Fuel tanker unit** with a capacity of about 1,000 gal. of JP-4.
- **Translauncher semi-trailer** which transports the missile and supports it during launching. (Former translauncher weighed 23,000 lb., new unit only 15,000 lb.).

Feature of the new-style translauncher is that the rear bogie pillow tires can be removed by two men in five minutes. Reason is to get them out of the way of the missile's booster blast.

Power pack on a separate vehicle supplies all a.c. and d.c. electrical current and hydraulic and pneumatic power to check out the missile. It also has a ventilation system to cool the missile's avionic gear while on the ground.

Vehicle supplies fuel to start the missile's turbojet engine. Gasoline is used to start the gas turbine. As soon as the powerplant is operating it is switched to JP-4.

An inhabitable test pack mounted on the same type of vehicle as the power pack is also included to accomplish system and missile check-out. Feature is that roof can be raised to make it inhabitable while working with the missile, or it can be lowered two feet to fit into a C-130.

Only four vehicles are required at the launching site. Mace weapons can be fired one hour after they arrive. Vehicles required to fire the missile are truck-tractor, translauncher, power and test vehicle and nose and booster handling vehicle.

Handling Sequence

Mace is readied for flight by using the quadrant system of operation. First the translauncher is positioned correctly. Then the power-pack truck is stationed on the translauncher's left side and the fueling vehicle pulls up on the right. All power cables and hose running from servicing vehicles to the missile are supported by overhead booms to keep them out of the way of ground personnel working around the missile.

Simultaneously, nose-and-booster vehicle pulls in front of the missile and the nose, which has six degrees of motion, is manually mounted on Mace. Then truck is driven around to the rear and the booster is hand-winched into place. Truck leaves the area.

As soon as the fueling truck has finished its job it leaves and translauncher's bogie tires are pulled out to the right side.

When Mace has been checked out, it is elevated to launching attitude and power-pack vehicle moves it to a safe spot some 150 ft. away. Then missile's engine is started and it is launched.

Among back area vehicles used for the Mace weapon system are:

- **Calibration van** of the same, inhabitable, telescoping, shoe-box type as the test pack.
- **Crane vehicle,** with 8-ton capacity, used to unpack parts from crates and

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Aerodynamics Engineer. Aerodynamics Engineer with A.E., or equivalent, and at least 3 years experience. To work on supersonic aircraft and missiles in aerodynamic analyses of performance, air loads, stability and control, or fluid mechanics.

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in′ge·nu′i·ty: *designing a 12-ton missile to fit inside an atomic sub*

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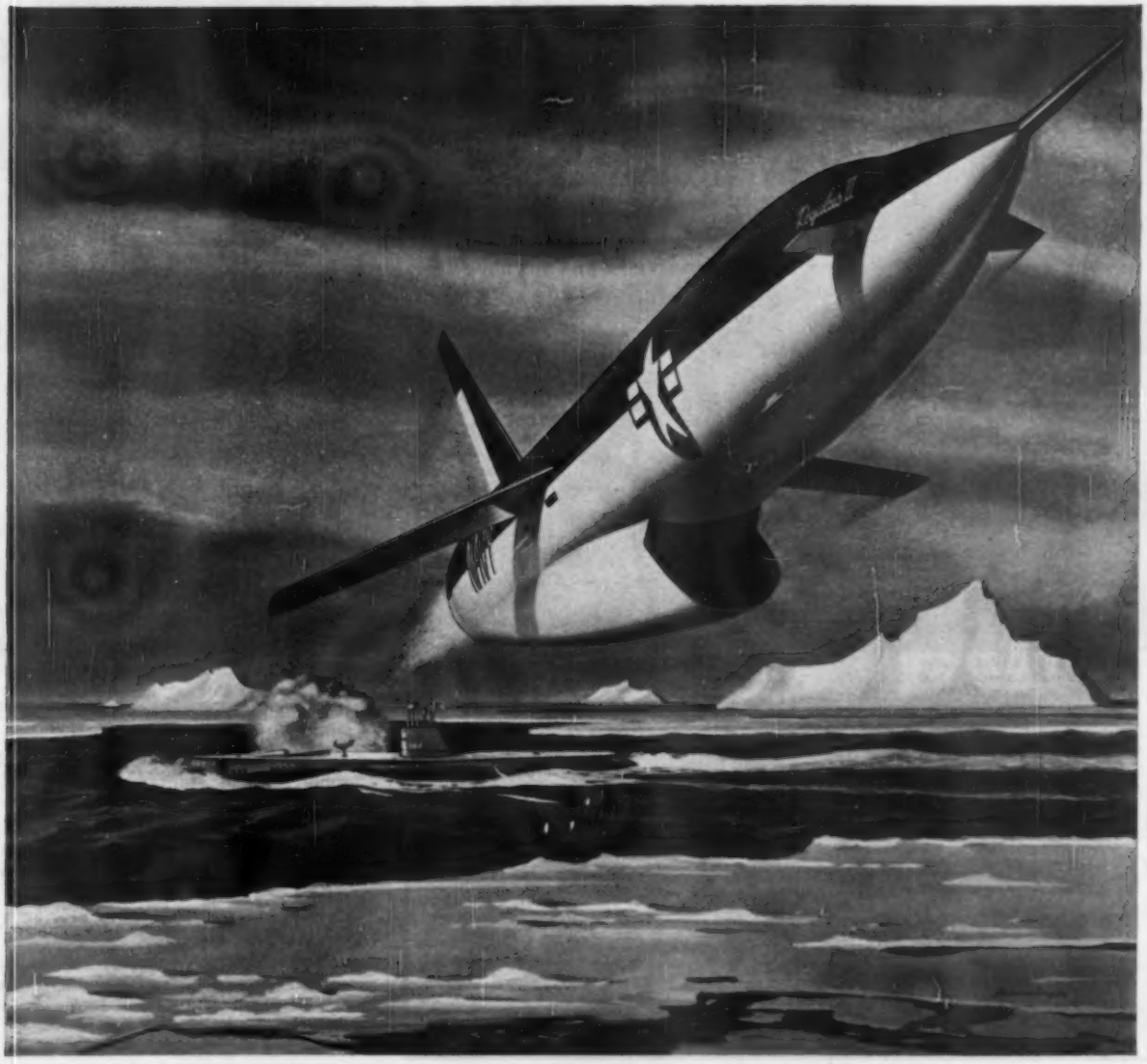

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The beautiful R3Y-1 Tradewind, illustrated above, is just one of six Convair models available. The plane is navy blue lacquered body with gold plated base and pedestal. Ashtray insert is amber glass.

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The Nike Hercules has a clear plastic base and pedestal. The missile is white with markings. It is one of four Douglas missile plastic desk models.

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place them on the proper vehicles.
• **Subsystem's** communications van that provides a complete network of radio communications channels.

Additional adjuncts to the weapon system are rolli-tankers—liquid-holding Teracruzer-type tires which can be towed in trains over rough terrain to supply the organization with all its required fluids. Each tire holds about 550 gal. Maximum speed for the mobile weapon system is 40 mph., according to Goodyear officials.

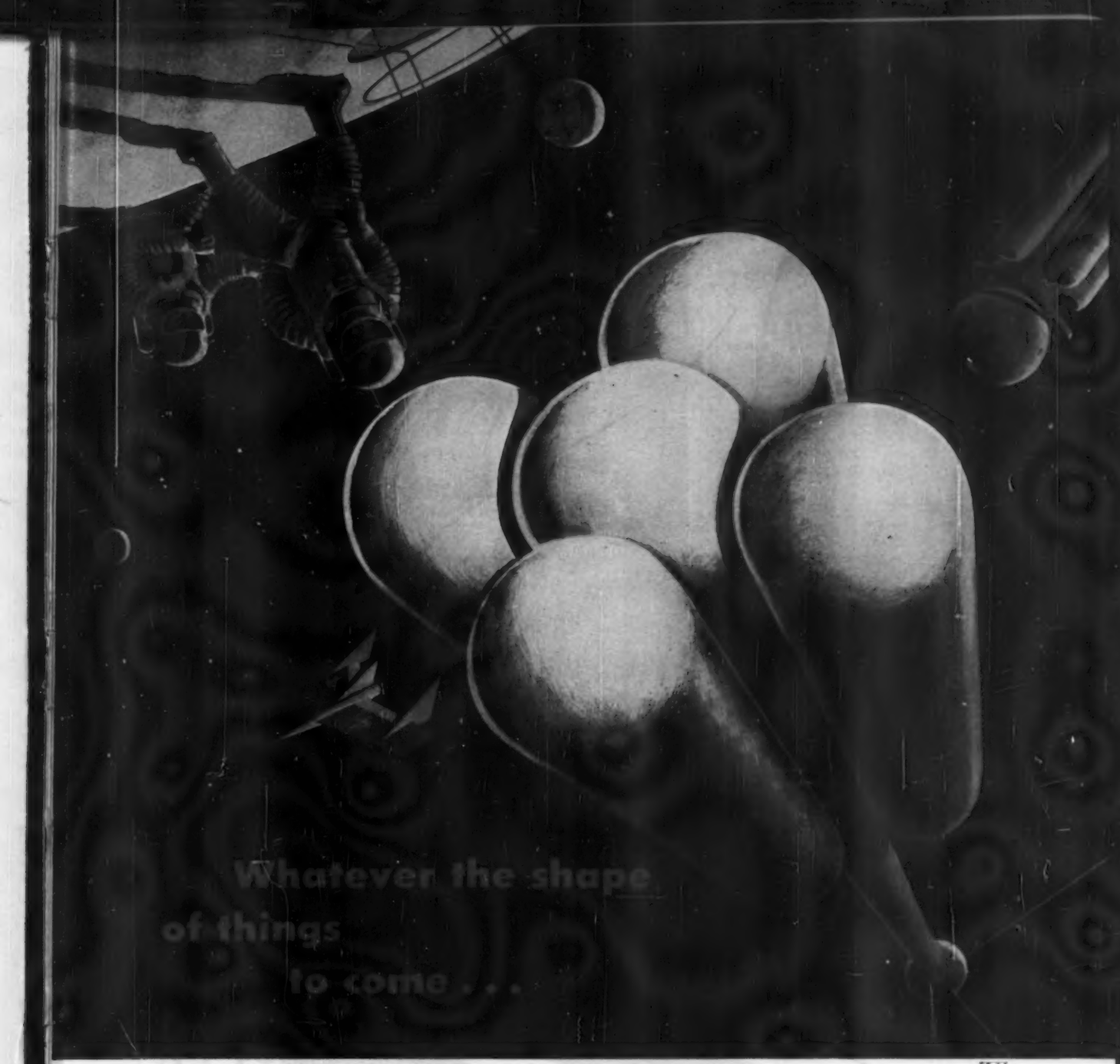
Fruehauf's Products

Company which has entrenched itself deeply in the missile ground support business is Fruehauf Trailer Co., Detroit, Michigan. Some of the products of the company's Missile Products Division include:

• **Atlas engine** transtainer trailer. Vehicle's engine mounting points correspond to those on the missile itself so that engine can be mounted on the trailer in exactly the same manner as it is attached to Atlas. Trailer has a plastic cover which can be hermetically sealed and a dessicant introduced for humidity control.
• **Jupiter transporter** being designed for Army. Carrier incorporates a special suspension system which combines torsion bar and hydraulic shock absorbing devices to prevent resonating shock waves. Suspension system is an adaptation of an earlier design Fruehauf made for Redstone missile.
• **Redstone transporter** units, three in all: thrust unit trailer which becomes the missile's assembly fixture in the field, warhead unit trailer and aft unit carrier. Feature of the Redstone system is wheel-mounted jacks that raise missile covers slightly so that the body of the missile can be moved away. As soon as covers are removed, warhead is assembled to the aft body, this assembly joined to the thrust unit. Missile then is erected by a winch pulling it into firing position with a cable slung over an "A" frame, eliminating the need for a crane.
• **Regulus II transporter** and launcher plus a storage container capable of being mounted on a trailer for transportation. Company also is building a dolly for the missile's booster.

Other Fruehauf-designed missile ground support equipment includes:
• **Thor vans,** transporters, dollies and pallets being made for Douglas.
• **Nike-Ajax** guidance system trailers.
• **Nike-Hercules** guidance system trailers.
• **Mace** TM-76A translaunchers.
• **Genie** positioning dollies.
• **Hawk radar** antenna vehicle is being redesigned to give a softer ride and center of gravity is being lowered for greater stability.

Here is a summary of other ground



58-16

Fantastic shapes for the space vehicles of the future already are on the boards. Even more radical designs are taking form in the minds of engineers. And their parts and components will just as radically differ from those produced today. New standards of precision and new methods of working new materials will be required.

One thing at least is certain: the same design, development and manufacturing experience which made the transition from aircraft piston engines to jets will be needed to produce these shapes of the future. Since the early 1920's, Ex-Cell-O has been among the major suppliers of machines, parts and assemblies to the aircraft industry. In that time it has built a reputation for extending the frontiers of precision.

Today, Ex-Cell-O manufactures such components as: rotors, blades, fuel nozzles, actuators, valves and fuel controls. Tomorrow? Well, perhaps you yourself have a problem which Ex-Cell-O's long experience in the production of precision controls and assemblies might help you solve. If so, why not contact Ex-Cell-O today?

EX-CELL-O FOR PRECISION XLO

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Aircraft Division

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O.

THE MISSILE MEN

From the earliest Assyrian "artillery missile"—with the flint-tipped warhead and hawk feathers for a guidance system—the fate of nations has been in the hands of the missile men.

Today, our strength in military missilery may hold the key to survival.

Martin based its long-range planning on that probability in 1946 with the development of one of this nation's first successfully operational guided missiles. The result is the *total missile* concept.

Under this concept, far more is involved in missile system contracting than the design and production of hardware:

The testing, packaging, delivery, maintenance, launching, operation, field training and contractor service requirements make up the *total* story of missile performance...in the air, and operated by the military personnel.

The heavy demands of our country's greatly accelerated missile and space development programs now emphasize the importance of Martin's total capabilities as a major resource for the military and astroscientific branches of the government.

Among those capabilities are three plant facilities which include the newest and most advanced missile development centers in the world.

Also part of these Martin capabilities is one of the great U. S. resources in manpower: More than 3,000 specialist engineers, trained and teamed in the *total missile* concept.

This is one of the few systematically organized companies of genuine Missile Men in the country.

MARTIN

BALTIMORE·DENVER·ORLANDO

support and handling equipment being made in this country:

Cambridge Corp. recently delivered what the company terms world's largest airborne tank to supply liquid oxygen for the Thor IRBM. The giant Thermos bottle, which is 50 ft. long, 8 ft. high and weighs 32,000 lb. stores 13,500 gal. of liquid oxygen at −297.4F. Feature of the unit is that it is light enough to be air-transportable in a Douglas C-133, yet strong enough to carry 170,000 lb. of liquid oxygen when full. This was accomplished by making the outer shell of aluminum, the inner container of stainless steel.

Another development to facilitate handling very cold liquid oxygen and to cut its tendency to boil off to a minimum, is a high vacuum-jacketed transfer line.

Because the lines have a heat transfer rate as low as 5.5 – 11Btu/ft./hr., fueling losses are reduced up to 50%, according to the manufacturer, Consolidated Electrodynamics Corp.

Vacuum jacket around transfer line is pumped out to a pressure of 1 x 10^{-4} mm. Hg or lower. Jacketed lines are currently available in sections up to 40 ft. in length and in sizes of 1¼ in. and 3 in.

Helicop-Huts, shelters and vans which are small and light enough to be carried internally by a Fairchild C-119 transport or externally by a Vertol H-21 helicopter, are going into production for use at Cape Canaveral. Manufacturer is Craig Systems, Inc.

Missile Handling Vehicles

Two new types of missile handling vehicles being produced by Food Machinery and Chemical Corp.'s Ordnance Division are:

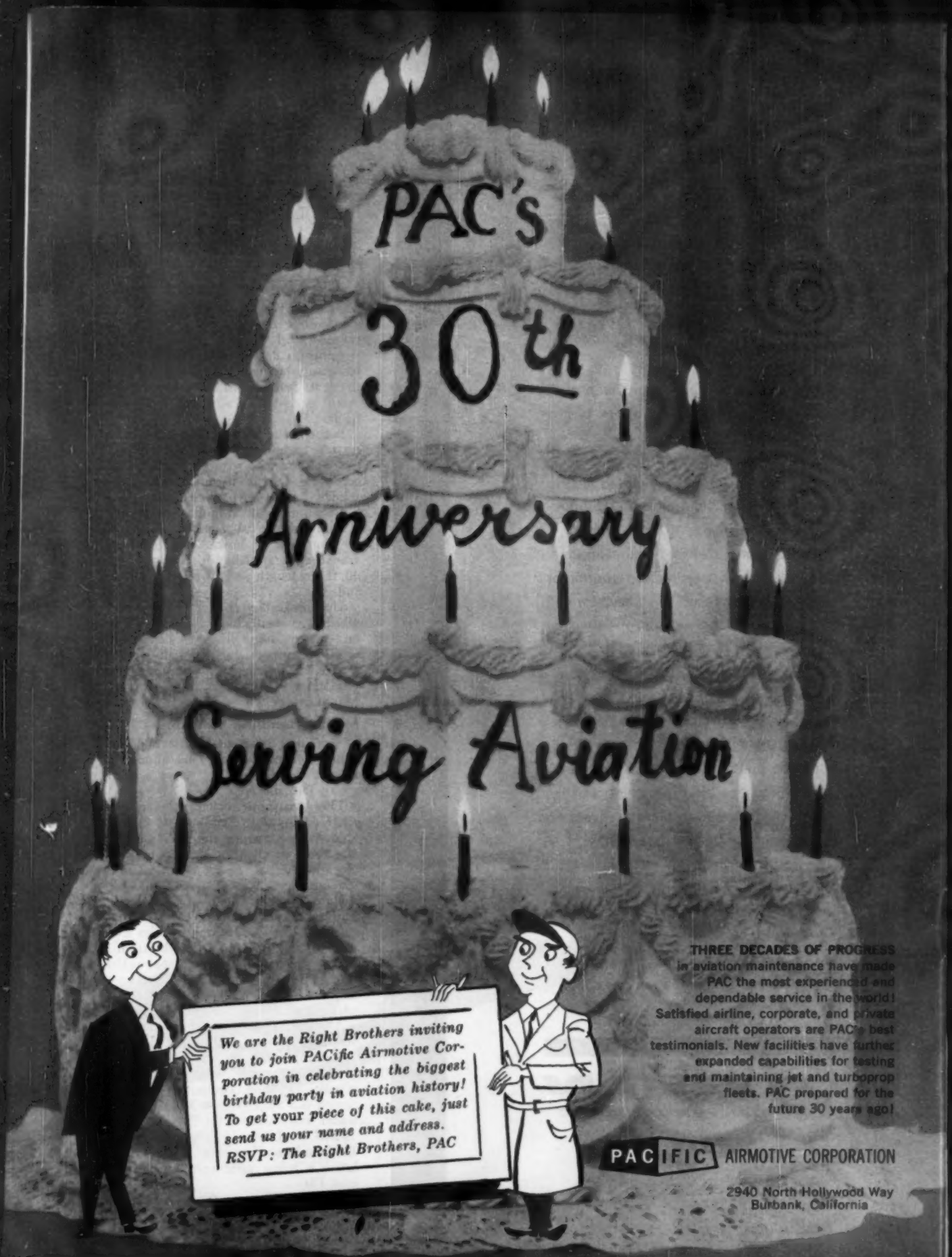
• **Thor transporter-erector** trailer, currently going into production. Associated systems include the hydraulic and electronic mechanism needed to actuate the initial steps of the firing sequence.

• **Hawk missile handling** vehicle, a self-propelled, tracked vehicle which picks up three 16-ft. long missiles with ease. Transporter takes Hawks from a special transport and storage pallet, moves them across difficult terrain—it can also negotiate 30 in. of water—and places the missiles on the launcher.

Vehicle is powered by a standard Jeep engine and can be carried by plane or helicopter.

One of the most complex pieces of missile handling equipment yet designed is a Ship Motion Simulator now under construction for Navy's Polaris IRBM by Loewy-Hydropress Division, Baldwin-Lima-Hamilton Corp. Installation is being made near Cape Canaveral, Fla.

Hydraulically-operated simulator can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RSVP: The Right Brothers, PAC
THREE DECADES OF PROGRESS in aviation maintenance have made PAC the most experienced and dependable service in the world! Satisfied airline, corporate, and private aircraft operators are PAC's best testimonials. New facilities have further expanded capabilities for testing and maintaining jet and turboprop fleets. PAC prepared for the future 30 years ago!
PACIFIC AIRMOTIVE CORPORATION
2940 North Hollywood Way
Burbank, California

put the multi-ton missile through most of the motions it would be subjected to on board a surface ship or a submarine.

An adapter moves the missile's center of gravity further away from the ship's (simulator's) CG to duplicate effects of a surface ship. When adapter is removed, missile and simulator's centers of gravity are brought close together as would be the case were the missile launched from a submarine.

Company also makes the test and launching stand from which Vanguard rockets are being launched at Cape Canaveral.

Titan Transtainers

At least three companies have designed transtainers for one or another of the Martin Co.'s Titan ICBM.

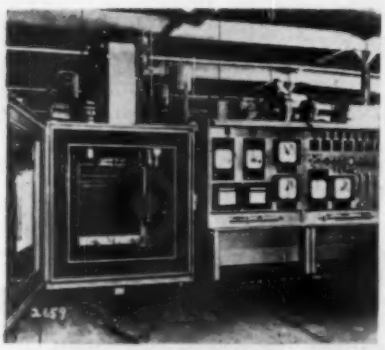
• **North American Aviation** is building two sizes of transtainers for the ICBM's first and second stages under subcontract to Martin. Vehicles are approximately 60 ft. and 36 ft. long, each. Transtainers are made of steel and aluminum, include gravel shields to protect the missile, air-oil shock struts to absorb road shock and a slide fastener-equipped waterproof cover to protect the entire missile stage from weather and dampness.

• **Fruehauf Trailer** has made a smaller transtainer for a Titan engine.

• **Cleveland Pneumatic Co.** designed transtainers for Titan's first and second stages. Vehicles included special shock absorbing gear and hermetically sealed nylon covers for the stages.

The humidity and pressure of air within the covers could thus be regulated as desired.

While company has not received contracts for the transtainers, it anticipates expanding into other facets of missile ground handling and support equipment.



Dual Environment Tester

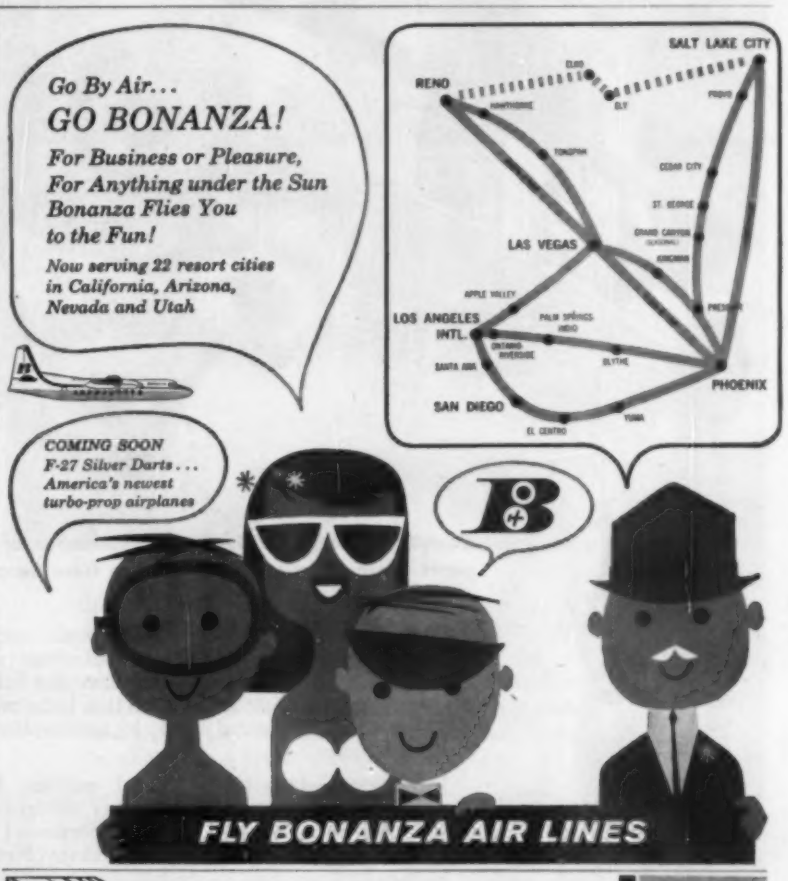
Environmental test chambers designed by Tenney Engineering, Inc., Union, N. J., consists of an environmental "package" within an environmental chamber. Used by Sperry Gyroscope Co. to test B-58 equipment, unit is said to be the first of its kind to be produced. Unit has separate sets of heating, altitude and cooling controls, permitting two separate environmental conditions to be simulated inside the same chamber. For example, the chamber may be set at high temperature and the package at low—or another combination of environment conditions may be set up. Package is positioned inside the chamber atop a vibrator, so that in addition to climatic conditions, equipment may be subjected to shock and vibration. Controls are connected to an instrument console for automatic operation and centralized control.

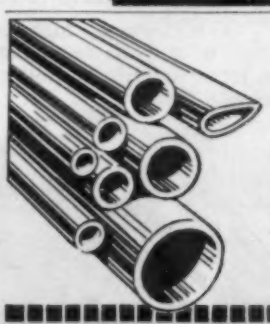
Synthetic Rubber Use Planned for Aircraft

First commercial production of Viton synthetic rubber will begin in April, according to E. I. du Pont de Nemours and Co., Inc.

A copolymer of vinylidene fluoride and hexafluoropropylene, Viton contains about 65% fluorine by weight. The material is designed for use primarily in structures and components where oil resistance at high temperatures (400 to 550F) is required.

In pilot plant production since 1956, Viton is finding applications in aircraft





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*Such leading manufacturers as Sikorsky, Bell, Kaman and Vertol are regular users of the typical Rollway precision helicopter bearings shown here.

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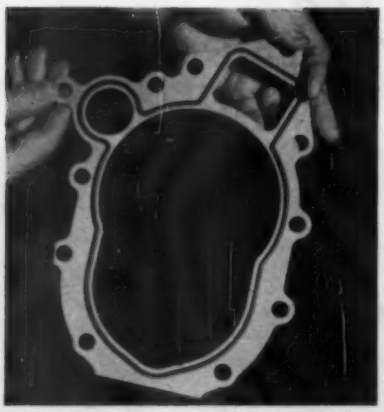

PARKER Seal Co. molds Viton on gasket.

seals and hose. It also shows promise in the fabrication of aircraft fire walls and vapor barriers. One formulator is using solutions of the copolymer to make high temperature paints for missiles. Other promising possibilities include protective, fire-retardant covers for missiles to be used during fueling operations and flexible fuel tanks for both missiles and aircraft.

Viton, according to Du Pont, has the high heat resistance of silicones but with an oil resistance at high temperatures. (Low temperature properties are poorer than those of the silicones.) It is much more resilient than the fluorocarbon plastics and is said to be much easier to process. Present price to fabricators is $15 lb.—about twice that of the fluoricarbon plastic and about three times that of the silicones.

WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Selected Bibliography: Fatigue, Stress, Body Change and Behavior—by W. Bevan and R. M. Patton, Lockheed Aircraft Corp. for Wright Air Development Center, U. S. Air Force. $1.75; 69pp; (PB 131299).

A Brief Study of the Suitability of Titanium and a Titanium Alloy as Firewall Material—by C. A. Hughes, Technical Development Center, Civil Aeronautics Administration, for Wright Air Development Center, U. S. Air Force. $.50; 10pp.; (PB 131392)

The Properties of Titanium Alloys at Elevated Temperatures—by F. R. Schwartzberg, F. C. Holden, H. R. Ogden and R. I. Jaffee, Titanium Metallurgical Laboratory, Battelle Memorial Institute, for Office of Assistant Secretary of Defense for Research and Development. $6.00; 228 pp.; (PB 121634).

AERODYNAMICISTS & STRUCTURES ENGINEERS

VERTICAL TAKE-OFF...

...a new Landmark of Aviation Progress

Bell Aircraft now presents the opportunity to be associated with the development of high-performance, jet aircraft which will take off and land vertically in a conventional attitude. Two test vehicles, one of them the X-14, have been flown successfully, and an operational aircraft is now being designed for the United States Navy.

Expansion of this VTOL program has created openings for experienced aerodynamicists and structures engineers with experience in these fields:

- Structural Design and Analysis
- Flutter and Vibration
- Flight Control Systems
- Propulsion Systems Design and Analysis
- Armament and Installation Layout

Here are challenging, long-range opportunities to participate in the production of the planes of tomorrow. Salaries commensurate with your background, good living and working conditions, and liberal benefits. Please write: Supervisor of Engineering Employment, Dept. E-29, BELL AIRCRAFT CORPORATION, P. O. Box 1, Buffalo 5, N. Y.

BELL Aircraft corp

Comfort...Vertol 44...Brussels World's Fair

Among the many firsts on show at the Brussels World's Fair is the new multi-city helicommuter service which links the Fair grounds directly to airports in Paris, Rotterdam, Cologne and Bonn. SABENA Belgian World Airlines operates these flights right to the heart of the Fair...and Vertol 44 tandem-rotor helicopters play an important part in the operation.

These stable, comfortable craft are a logical choice for such an assignment. They can seat up to 15 passengers in their long, airliner-type cabin—provide a window next to every set of seats, a cabin-long luggage rack—and permit free movement in flight by passengers.

A lavatory is provided for long-stage flights. The cabins have been insulated against sound and vibration. All of it adds up to more fun, more comfort...more satisfied passengers.

Vertol 44's are also available as utility transports capable of airlifting up to 19 passengers or 2 1/2 tons of cargo. This version performs multiple duties in petroleum, mining, lumbering or construction.

VERTOL *Aircraft Corporation*

MORTON, PENNSYLVANIA

SUBSIDIARY: ALLIED RESEARCH ASSOCIATES, INC., BOSTON, MASS.

Fair Shows German Aviation Comeback

Hanover, Germany—German aviation industry's second postwar air show and flying display, held at Langenhagen airport here, emphasized business and sport flying.

The German airplanes flown in demonstrations during the ten-day air show were:

• **Dornier Do-27** single-engine, six-seater all-metal STOL plane, made by Dornier-Werke GmbH, Munich.

• **Blume B1.502** single-engine, four-seater all-metal busines or sport plane, a private development by Prof. W. Blume, Duisburg.

• **Klemm K1.107B** single-engine, three-seater business or sport plane costing $9,100 for the standard version and $9,800 for the de luxe model. The design is a joint effort by Ludwig Bölkow of Bölkow-Entwicklungen K.G., Stuttgart, and Dr. Hanns Klemm of the Klemm-Flugzeuge GmbH, Böblingen. First production run is now being made at Böblingen.

• **Multoplane RW.3** two-seater sport plane powered by a single 65 hp. converted Porsche automobile engine.

• **Burgfalke M-150** Schulmeister business and sport craft powered by a single 65 hp. engine. Maker is the Burgfalke Flugzeugbau, Burglengenfeld.

• **Scheibe SF-23A-C90** Sperling single-engine, two-seater sport plane made by Scheibe Flugzeugbau GmbH, Dachau, near Munich.

• **Pützer Elster** single-engine, two-seater, all-wood sport plane made by Pützer K.G., Bonn. Price is about $3,500.

• **Stark Turbulent** single-engine sport plane, all-wood airframe, made by Stark K.G., Minden, Westphalia. Price is about $3,250.

K1.107B is displayed at Hanover Fair, costs from $9,100 to $9,800 in two models.

In addition, flight demonstrations were made by 11 non-German aircraft including three helicopters:

• **Kolibrie** multi-purpose ramjet made by Nederlandse Helicopter Industrie, Rotterdam.

• **Bristol Sycamore** which was running a shuttle service between the air show and the Hanover Fair.

• **Vertol** Model 44.

The Kolibrie (AW April 28, p. 85-86) was piloted by the company's chief test pilot, R. J. van der Harten, who demonstrated the helicopter's maneuverability. Interest in this machine centers around its potential use as a helicopter trainer. Agricultural officials in the Bonn area also were to see its versatility demonstrated.

Other non-German exhibits were the Fouga C.M.170R Magister of French design, now being made under license in Germany by the Flugzeug-Union-Süd GmbH, Munich; de Havilland Dove; Beech Twin-Bonanza E50; Cessna 310; Piper Comanche; Mooney Mk. 20; Helio Courier and Super Aero twin-engine, four-seater, all-metal plane, exported by Omnipol A.G., Prague, Czechoslovakia.

Static exhibitions included displays by about 160 makers of aeronautical instruments and accessories. British Martin-Baker Mk. 3H ejection seat stand and Porsche display showing the aero engine conversion generated considerable interest. Martin-Baker staged a low-level ejection demonstration from the runway before high ranking Luftwaffe officers from Bonn.

Germany's first postwar air show last year formed only a very small part of the Hanover Fair, and was located in the fair buildings. But the German aircraft industry has been quick to realize the added value of a shop window located immediately adjacent to the airport in a setting of green fields and gaily colored flags, where every deplaning visitor to the Hanover Fair could see the aviation display.

Judging by Paris and Farnborough air display standards, the German show at Hanover was on a miniature scale, but the amount of interest shown by foreign and native visitors was an indication that the German aviation industry is well into its postwar comeback.

Piper Comanche 250 Cruises at 181 Mph.

Lock Haven, Pa.—New Piper Comanche 250, latest version of company's low-wing four-place business plane, has a cruise speed of 181 mph. at 75% power of its 250-hp. Lycoming 0540-A1A engine at 8,000 ft., according to first official details.

This performance compares with 160 mph. cruise speed under same conditions for earlier 180-hp. Comanche (AW Nov. 11, 1957, p. 100). Other performance gains shown by latest version include (180-hp. model in parenthesis): fully loaded rate of climb, 1,400 fpm. (910 fpm.); service ceiling, 20,000 ft. (18,500 ft.). Useful load of Comanche 250 is 1,200 lb. (1,105 lb. in Comanche 180); baggage capacity is 200 lb. (100 lb.). New version's gross allowable weight has been increased 250 lb. to 2,800 lb. while empty weight has gone up 145 lb.

Like the Comanche 180, the newer 250 is being delivered in three models: Standard priced at $17,900; Custom at $19,650 and the Super Custom at $21,250. Super Custom substitutes a 27-channel Narco Omnigator Mk. II for the 12-channel Narco Superhomer in the Custom version, also includes a Lear ADF-12E direction finder, broadcast receiver, radio range and communications receiver.

Piper is building all Comanches, including the 180-hp. model, exactly the same aft of the firewall, starting with serial 103.

NEW TOOL FOR USAF's NEW TRAINING CONCEPT!

To increase
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unique side-by-side seating,
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Cadets learn faster,
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CESSNA AIRCRAFT CO., WICHITA, KANS.

Cessna

Bay Aviation Services Plans Jetliner Hangar

San Francisco—Bay Aviation Services Co., which set up a business aircraft service operation at San Francisco's former airport terminal in 1956, is awaiting final approval from the city of its financial plans covering erection of a $500,000 cantilever hangar 160-ft. x 280-ft.

Hangar will be capable of housing two four-jet transports. Bay Aviation officials hope to expand operations to include maintenance and overhaul for foreign carriers which do not have their own facilities in this country.

Executive aircraft operations show an increase of 20% for the last half of 1957 compared with the same period in the previous year, with some 3,800 aircraft moving in and out of the airport July through December. The 1957 period was higher despite the fact that more than 625 airplanes, most of them multi-engine, used the airport in one five-day period during the 1956 Republican Convention in San Francisco. Bay Aviation facilities include hangar space and tiedowns for 100 aircraft and could be expanded to accommodate more than 200 using 13 acres of leased land.

In addition to Cessna dealership and service facilities for aircraft and avionics equipment, the company also has contracts to fuel planes of Japan Air Lines, Qantas, BOAC and Slick.

Cessna on Skis

Cessna's new Model 175 (AW Mar. 24, p. 79) has been approved for Federal tricycle ski gear and Edo 338-2200 floats following flight tests with the new equipment in Oklahoma and Minneapolis. Skis are wheel replacement type requiring no special fittings.

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Engineering research teams at Northrop today are exploring the laws and forces of the Universe which will guide our interplanetary paths tomorrow. Projects concerning advanced design missiles, space platforms, and similar complex tasks now under way reach far into the future and exceed the capabilities of engineers with average experience. Engineering specialists and senior engineers of superior abilities and dedicated vision are finding unmatched challenges at Northrop. A limited number of additional positions of highest responsibility requiring advanced degrees or demonstrated capabilities are available in the following fields:

PROPULSION SYSTEMS PERFORMANCE

Engineering specialists with advanced propulsion systems experience are required to set up study programs directing the efforts of other engineers. These men should be familiar with automatic computing techniques, and the problems inherent in integrating propulsion systems with overall vehicle objectives.

Senior engineers with majors in propulsion or physics are required, preferably with at least five years of experience in the aircraft or missile field. Positions call for direction of project effort in research investigations and Advanced Design proposals, setting up projects, making analyses of propulsion problems of test data, and directing the efforts of others.

INTERNAL AERODYNAMICS

Senior aeronautical engineers are required in this area to perform advanced inlet system design and performance analyses in support of Northrop's advanced design effort. These men will be responsible for preliminary research investigation of data, determination of design criteria, and analytical methods in internal aerodynamics and propulsion performance. They will define the geometry and performance of advanced induction systems for air-breathing engines and develop the requirements for induction systems control. Experience in internal aerodynamics is essential; experience in testing techniques is extremely desirable.

AEROTHERMODYNAMICS

Challenging positions are open for performing advanced analyses in boundary layer, heat transfer, mass transfer, jet effects and hypersonic real gas flow fields. These men will provide technical direction in the field of aerothermodynamics for advanced design and development projects, including analytical and experimental program responsibility. They will also develop criteria for the evaluation of aerothermodynamic design aspects of extreme high speed flight.

FLUID DYNAMICS RESEARCH

Senior engineers and engineering specialists are needed to conduct applied research projects throughout the broad field of fluid dynamics. Involved are projects in the study of unsteady aerodynamics, hypersonic flow field, aerothermoelasticity, separated flow fields, laminar and turbulent boundary layers and dynamic stability. Research is also directed toward establishment of advanced testing techniques and the utilization of IBM 704 high-speed computers for the solution of technical problems.

AERODYNAMICS DEVELOPMENT

Engineering specialists and senior engineers are required to conduct analyses in stability control, aeroelasticity and maneuverability to define flying qualities. Assignments include establishment of configuration geometry which will optimize flying qualities commensurate with design requirements.

★ ★ ★

The men selected to join Northrop's distinguished engineering staff in these positions are those who even now are well recognized in their fields. The environment and facilities at Northrop are among the finest in the industry, and are conducive to the type of engineering research leading to rapid technical and professional growth.

Confidential conferences will be arranged at your convenience. Please telephone, wire or write to Mr. A. A. Aitken, Manager, Engineering and Scientific Personnel Administration.

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Okanagan Reports Gains In Helicopter Operations

Contract operations by Okanagan Helicopters, Ltd., in Canada during 1957 covered more than 22,000 flying hr. compared with the last year's 16,000, bringing the organization's rotary wing experience to over 70,000 hr.

Gross revenues in 1957 came to $2,882,000 compared to the previous year's $1,942,000 and net profits were $312,586 compared to 1956's $220,222. Prospects for 1958 appear to be good, the firm reports, with all of its helicopters committed. In 1958 Okanagan will be operating one Sikorsky S-58, 21 Sikorsky S-55s and 30 Bells throughout Canada. Employes have increased to 160 aircrew and other personnel.

PRIVATE LINES

CAA has assigned a block of 200 aircraft registrations with suffix letters "MD" for use by members of Flying Physicians Assn. FPA members may obtain special registration by requesting new registration from Aircraft & Airman Records Branch, Civil Aeronautics Administration, Department of Commerce, Washington 25, D. C., and paying the required special number fee of $10. Block available runs N786MD through N998MD with exception of some numbers already assigned.

New Argentine designed and built aircraft include I.A.45 and I.A.46. Former is a four-five-place all-metal low-wing monoplane with retractable tricycle landing gear, has two 150-hp. Lycomings; latter is powered by a single 150-hp. Lycoming.

Sunny South Aircraft Service inaugurated 24-hr. line service at Broward County (Fla.) International Airport. Airport manager reports application has been made to CAA to approve 24-hr. control tower operations since he estimates some 6,000 operations annually between 11 p.m.-7 a.m. Airport recorded 86,577 operations last year. In 1952 there were 226,000 gal. of fuel sold at the field; last year there were 1.5 million gal. dispensed. In 1952 there were two aircraft service firms employing 25 on the field, there are now six and one airline employing more than 200.

New Beech distributor for northern California and northern Nevada is Cochran Aviation, Inc., Oakland, replacing Pacific Aircraft Sales Co.

First Piper Comanche to fly Atlantic went directly from Miami to Bermuda, then to Santa Maria in the Azores and

Controls Development at Marquardt

by
Roy E. Marquardt,
President

Marquardt was established in early 1944. Concurrently with the early development of the ramjet engine, controls had to be designed which would operate within the ramjet engine under severe environmental conditions.

The extreme velocity and acceleration of the engines created controls requirements well beyond the limits of the turbojets then in development and operation.

Marquardt engineers and scientists solved these early controls problems... creating components which produced reliable performance in the high Mach ranges; and today under Chief Engineer Tony Kreiner have gone on to develop a family of even more advanced controls and accessories:

In rotating accessories, Marquardt's pioneering turbine and pump work has culminated in emergency power units for the Chance Vought F8U-1 Crusader, and the Lockheed F-104 Star Fighter.

In the area of supersonic engine inlets, Marquardt engineers and scientists have been engaged in broad research and development programs for the past ten years. This aero-thermo knowledge coupled with our controls background has led to applications for variable geometry inlet control systems on North American's Hound Dog electronic countermeasures missile and McDonnell's twin-engine all-weather fighter.

And in afterburner controls, exit nozzles, noise suppressors and nuclear controls, Marquardt engineers have and continue to achieve significant engineering breakthroughs.

Professional engineers will find a broad range of challenging assignments and projects at Marquardt, plus opportunity to further their careers through supplemental educational programs.

For information about the professional engineering environment at Marquardt, we invite you to contact Jim Dale, Professional Personnel today.

Roy E Marquardt

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Marquardt Means Opportunity–Controls Engineers will find a spectrum of projects ranging from variable inlet geometry to nuclear engine controls at Marquardt Aircraft, the company where an ENGINEER/BARRIER* has never existed. Here in a professional engineering environment you will work with a management that recognizes and rewards the contributions of engineers. Look to your future by looking to Marquardt, today.

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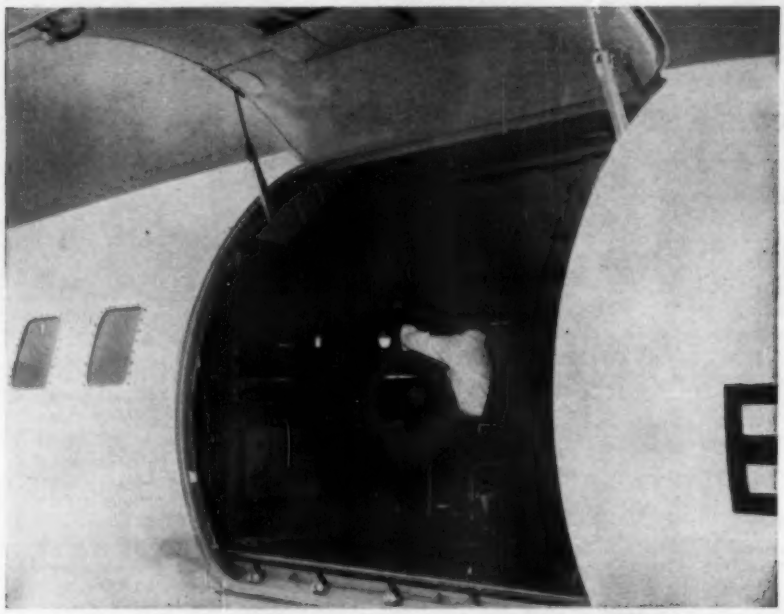
Shown here–A. J. Kreiner, Chief Engineer Controls & Accessories Sub-Division

*ENGINEER | BARRIER–an achievement level beyond which you cannot advance

ENGINEER OPPORTUNITIES AT RAYTHEON



DOPPLER NAVIGATION EQUIPMENT is readied for flight testing under operational conditions. Engineers at the Maynard Laboratory hold responsibility for program from initial study phase through prototype production.

Newly formed project groups solve complex airborne radar problems

Engineers like the project-type organization at Raytheon's Maynard Laboratory. It gives them maximum diversification in their work on the most advanced radar navigational and control problems of the day.

At Maynard, you'll find projects involving many areas of aircraft navigation and guidance systems . . . doppler navigation, velocity check systems, night-fighter operations systems, flight-control systems, altimeters. There is also interesting new work on countermeasures equipment.

Career opportunities for men at all levels now exist in the following areas:

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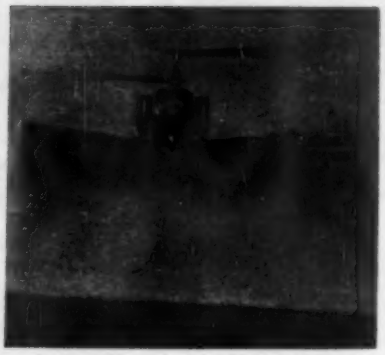


Ka-15 Sprays Field

Small two-place coaxial rotor Kamov Ka-15 Hen is being delivered in small quantities for several applications. Shown is the agricultural model dispensing chemicals from spray booms extending from the bottom of the fuselage. Chemical tanks are located on each side of the fuselage. Another model, fitted with floats, operates with the Soviet Antarctic whaling fleet. Larger, four-place coaxial Kamov Ka-18 Hog (AW April 7, p. 45) has passed its flight tests and will soon go into quantity production.

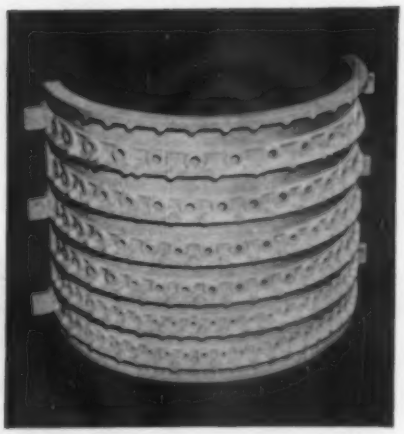
from there to Lisbon, the Bermuda-Azores leg being 2,100 mi. Airplane was fitted with 146-gal. auxiliary fuel tank in the cabin, which, combined with its standard 60-gal. tankage, gave aircraft a still-air range of 3,700 mi. The Comanche was accompanied by a light twin Piper Apache destined for Holland.

Hertz began Rent-A-Plane service to 56 cities and plans to develop system to cover 100 cities by the end of this year. The subsidiary of the car rental company estimates that annual volume of its new operation will be $4 million in the first year of operation. Using a Cessna 172 or similar model, customer could fly for as little as $18 a day plus 13 cents per flight mile. On a Hertz Taxiplane (charter) basis, including services of a pilot, cost would be a minimum of $30 a day plus 18 cents a mile, plus 10% excise tax.

Delaware Aircraft Corp., Philadelphia International Airport, has been formed to handle a Piper distributorship covering central and southern New Jersey, Delaware and southeastern Pennsylvania. Company will also provide a flight operation.

A $1 million seaplane and helicopter base and marina will be built by New York City's Department of Marine & Aviation over the East River at East 23d St. for the Gulf Oil Corp. Construction of the facility, measuring 350 ft. x 125 ft., will begin in September. Facility will also provide parking for 396 cars under cover and 130 on the open roof.

Zirconium, thorium, cerium . . . strange names for little known, little used elements. But add them to magnesium, and a new family of metals appears. Preserving the high strength-weight ratio of the featherweight metal, they add high-temperature properties that have proved a necessity in high performance aircraft and missiles. A specialist in light metals casting, Rolle knows these alloys as you know the back of your own hand.



how to save weight at high temperatures

an introduction to the magnesium-rare earth-thorium alloys

One-fourth the weight of steel . . . two-thirds the weight of aluminum . . . magnesium has carved a featherweight niche for itself in modern materials engineering.

But the reputation won by the magnesium-aluminum zinc alloys was won at room temperatures. Where high temperatures obtain, the "structural" alloys are no longer structural, and the lesser known "premium" group comes into its own.

These alloys, providing excellent high temperature properties and creep resistance to 660F, are also characterized by

- uniform strength of varying cross-section
- high fatigue strength
- low notch sensitivity
- freedom from microporosity
- good stress rupture characteristics
- good founding qualities

Naturally, properties vary within the group, but a rough comparison of individual advantages can be drawn.

a profile of the "premium alloys"

ZK51A and ZE41XA are superior, fine grained alloys with high yield strength and ductility, excellent fatigue properties, low notch sensitivity, and they are pressure tight without impregnation. Alloy ZH62XA offers these same general properties but is stronger than ZK51A. The room temperature strength of ZH62XA is combined in a relatively new alloy, ZH42, with creep resistance to 480F.

Complete freedom from microporosity, excellent founding properties, and low heat treating temperatures, characterize EZ33A, a magnesium-zirconium-cerium alloy. Like ZH42, EZ33A resists creep to 480F, and possesses good tensile properties at both normal and elevated temperatures.

HZ32A, perhaps the most important alloy of the series, contains thorium rather than cerium. Equal to EZ33A in strength, founding properties, and heat treating characteristics, it resists creep to 660F.

ideal for engine castings

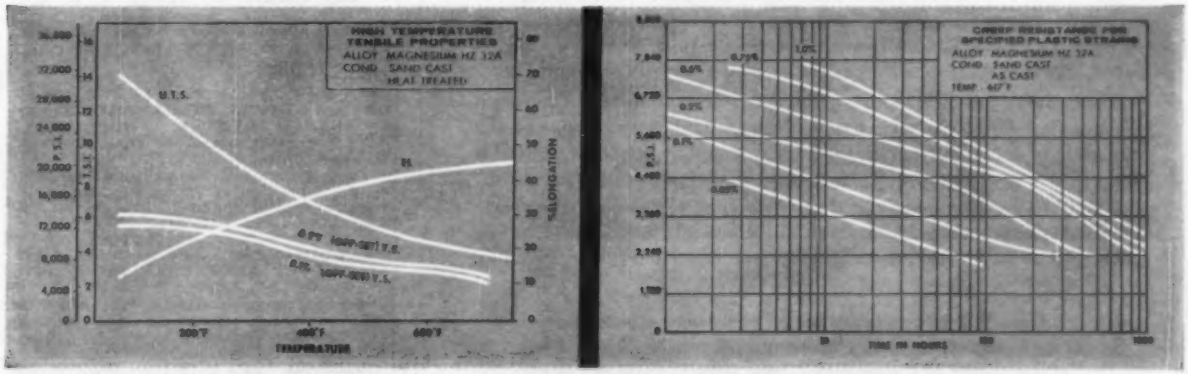
Though each of these "premium" alloys offers specific advantages, the benefits of HZ32A have undoubtedly been most impressive. Its unique heat resistance properties permit weight savings in stressed turbine engine parts with magnesium castings for the first time. A typical example is the part illustrated above . . . a jet engine compressor housing . . . sand cast by Rolle in HZ32A. Success of this alloy in such applications can be inferred from the two graphs—High Temperature Tensile Properties and Creep Resistance For Specified Plastic Strains.

maintaining specified properties

Chances are you spend hours . . . even days . . . studying the "book" specifications of a metal before you design it into a part. But the book you've been working with too often gets thrown out the window with the first production run. Getting the most out of the premium alloys and into the cast part is often a difficult task, but we feel we're in an ideal position to do just that. Sand, shell, and permanent mold casting the *light metals* . . . and *only* the light metals . . . is our business.

fifty-eight page engineering manual

A considerable amount of data on the design properties of the aluminum and magnesium alloys can be found between the covers of our light metals casting manual. We'll gladly send you a copy on letterhead request. Write Rolle Manufacturing Company, 309 Cannon Avenue, Lansdale, Pa., or call ULlysses 5-1174.



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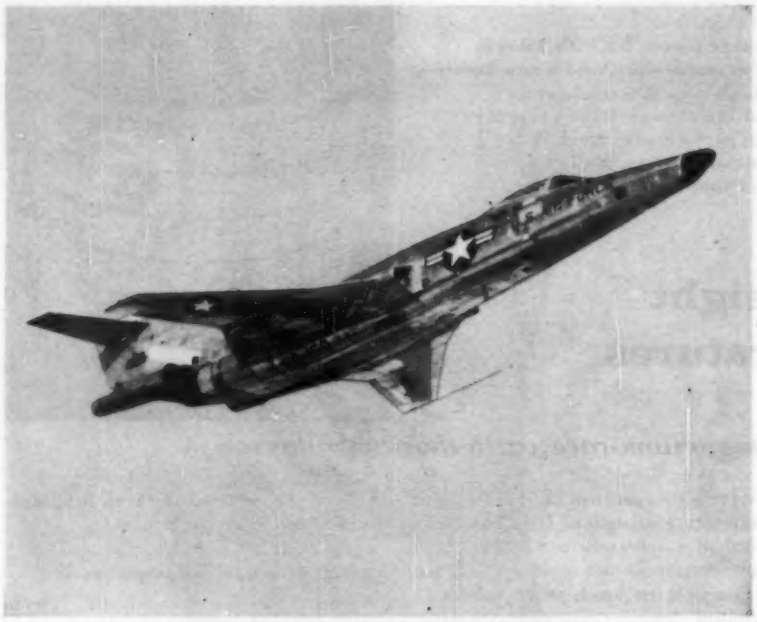

Evolution—the Voodoo—and the CWT

The headlines McDonnell's Voodoos are making today had their start more than ten years ago.

The XF-88, experimental forerunner of the Voodoo series, was in the air in 1948. From this prototype, the series evolved through six years of testing and research, and the first Voodoo was flown in 1954.

Today, the F-101A version of the Voodoo holds the world's speed record—1,207 mph. The RF-101A holds all three cross-country speed records. The F-101B, carrying the "Genie" air-to-air nuclear rocket, is capable of knocking down an entire formation of enemy bombers.

Throughout this development, the CWT—the Southern California Cooperative Wind Tunnel—has made important contributions to the evolution of the Voodoo. The XF-88 was tested at the CWT; tests for the F-101A were in progress as early as 1952.

The CWT has participated in the aerodynamic development of a wide range of military aircraft, missiles and commercial airplanes, including such craft as the Hustler, the Starfighter, the DC-8 and the Super Sabre.

The CWT serves its five owner companies, a number of governmental agencies, and other aircraft manufacturers. If you would like more information regarding its services and facilities you are invited to write us.

CWT
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Operated by the California Institute of Technology. Owned by Convair, Douglas, Lockheed, McDonnell and North American.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Air Force Contracting Offices:

U. S. ATOMIC ENERGY COMMISSION, Idaho Operations, Idaho Falls, Idaho.

W. R. Cahoon Construction Co., Pocatello, Idaho, construction of buildings, utilities and facilities for the STF Pool Facility Area, (AT(10-1)-897), $772,692.

HEADQUARTERS, SACRAMENTO AMA, USAF, McClellan AFB, McClellan, Calif.

B. F. Goodrich Aviation Products, Akron, Ohio, seal assemblies for cockpit enclosure, inflatable, RFP SM-8-01M-3011, $55,326.

The Fafnir Bearing Co., New Britain, Conn., bearings, (IFB 40-604-58-1904), $99,840.

Industrial Products Division, Boeing Airplane Co., Seattle, spares, (AF 40(604)-8229), $109,090.

United Motors Service Division, General Motors Corp., Detroit, spares, (IFB 40-604-58-1841), $81,157.

Quaker Rubber Division, H. K. Porter Co., Philadelphia, spares, (IFB 40-604-58-1892), $29,000.

Continental Motors Corp., Muskegon, Mich., services, (AF 40-604-58-8387), $124,999.

Beiser Aviation Corp., Tuscon, Ariz., IRAN, modification and transfer of T-6G aircraft, 39 ea., rehabilitation and transfer of T-34A aircraft, 2 each; (RFP nr SM-8-01A-2512 and SM-8-01A-3157), $608,425.

HEADQUARTERS, DOVER AFB, (1,607th Air Base Group, MATS), USAF, Dover AFB, Del.

Bituminous Construction Co., Baltimore, Md., repair roads and replace curbs and gutters, (IFB 07-603-58-37), $92,500.

HEADQUARTERS, SAN ANTONIO AMA, USAF, Kelly AFB, Texas.

The B. G. Corp., Ridgefield, N. J., 4708-BG340, spark plug, aircraft reciprocating, $408,400 ea., applicable to R4360-63A engines, (IFB 41-608-58-82), $467,944.

Champion Spark Plug Co., Toledo, Ohio, 4708-RHA37N, spark plug, aircraft, reciprocating, 1,700,800 ea., applicable to R2800, R3350 and R4360 engines, (IFB 41-608-58-99), $1,988,235.

DEPARTMENT OF THE AIR FORCE, Headquarters, USAF, Air Force Academy Construction Agency, P. O. Box 1670, Colorado Springs, Colo.

Douglas Jardine, Colorado Springs, Colo., construction of irrigation and topsoil, service and supply area; (IFB-05-613-38-32), $60,217.

HEADQUARTERS, AF CAMBRIDGE RESEARCH CENTER, ARDC, USAF, Laurence G. Hanscom Field, Bedford, Mass.

Eagle-Picher Co., Miami, Okla., research on the deposition of silicon tetraiodide and the development of doped single crystal silicon; AF19 (604)-3057, $29,865.

HEADQUARTERS, AF MISSILE TEST CENTER, ARDC, USAF, Patrick AFB, Fla.

Aeronca Manufacturing Corp., Baltimore, Md., improved attitude reading device; (PR-58-1060, contract AF-08-(606)-2506), $43,423.

Radiation, Inc., Melbourne, Fla., timing terminal unit, model 37260; (PR-58-1146, contract AF-08-(606)-2538), $25,000.

HEADQUARTERS, TOPEKA AFD, USAF, Topeka AFB, Topeka, Kan.

E. I. duPont de Nemours & Co., Wilmington, Del., methanol, 81,378 gal.; (IFB-14-604-58-9), $34,104.

Magnaflux Corp., Chicago, Ill., emulsifier, 27,500 gal.; (IFB-14-604-58-444), $70,895.

Northrop Aircraft, Inc., Hawthorne, Calif., target kit, 70 each; (production list OD-57-3), $52,949.

E. I. duPont de Nemours & Co., Wilmington, Del., methanol, 300,000 gal.; (IFB-14-604-58-9), $87,876.

WHO'S WHERE

(Continued from page 23)

Honors and Elections

The late **Capt. Kenneth D. Chandler**, winner of the 1957 Bendix Trophy Race, was awarded the third Oak Leaf Cluster to the Distinguished Flying Cross a week before his death. Announcement of the award arrived at his base after he was killed March 28 in a plane crash near Denver, Colo.

Dr. Karl Klager, manager of Aerojet-General Corp.'s Solid Propellant Development Division, has been awarded the U. S. Navy's Distinguished Public Service Award for his contributions to the Polaris Ballistic Missile program.

Col. James W. Anderson (USAF, ret.) has received the Award of the Legion of Merit. Col. Anderson organized the Directorate of Intelligence and Electronic Warfare of the Rome Air Development Center.

Changes

Stephen A. Busch, director of manufacturing, Fluid Systems Division, Waldorf Instrument Co., Huntington Station, N. Y.

Robert S. Mulligan, chief of material, Astrodyne, Inc., McGregor, Tex. **Lyle J. Babbitt** replaces Mr. Mulligan as general supervisor of supply, Purchasing Dept., Columbus Division, North American Aviation, Inc., Columbus, Ohio.

Harry H. Wetzel, manager, AiResearch Manufacturing Division, The Garrett Corp., Los Angeles, Calif.

Dr. Nicholas A. Begovich, director of engineering, Hughes Aircraft Company's Ground Systems Group, Fullerton, Calif. Also: **Dr. William T. Clary, Jr.**, head-systems analysis department; **John W. Bozeman**, director-data processing laboratory; **Robert Polkinghorn**, director-radar laboratory; **Samuel Langberg**, head-engineering services department.

Lockheed Aircraft Corp., Burbank, Calif. has announced the following appointments for airline and military sales: **Guy H. Evans**, director of sales-Europe, Africa and the Middle East with offices in Geneva, Switzerland; **James E. Boyce**, director of sales-Australia and the Far East with offices in Sydney, Australia.

Melvin Schoenberg, manager, Airline-Sales-Engineering Department, Greer Hydraulics, Inc., Jamaica, N. Y.

Rolland R. La Pelle, manager of sales and engineering-aircraft, missile and special research furnace projects, Heat and Control, Inc., San Francisco, Calif.

Edward J. Cousin, manager-space and missile programs, Allen B. du Mont Laboratories, Inc., Clifton, N. J.

W. E. Elder, manager-hydraulics engineering, Hydraulics Division, Dalmo Victor Co., Belmont, Calif.

E. A. Reynolds, manager, newly formed Department of Product Support, Convair-Astronautics, San Diego, Calif. **W. L. Van Horn** succeeds Mr. Reynolds as manager of long range planning, and **W. W. Pierce** has been named assistant to Mr. Reynolds.

Kermit A. Day, manager, Defense Products Division, The Brunswick-Balke-Collender Co., Chicago, Ill.

Things are humming at ROHR

Rohr's reputation in the aircraft industry was built on years of tremendous engineering knowledge in the field of ready-to-install power packages for airplanes.

Through planned diversification into other major aircraft components and industry-pacing development programs in new and far-reaching structural materials, Rohr's current quarter-billion backlog is nearly half in these fields.

The Rohr policy of building its engineering department over the years in a sound and gradual manner has proven highly gratifying to our engineering staff — and highly successful through the rapid growth of our company.

To maintain our position as the aircraft industry's leading producer of components, we are currently seeking a number of experienced AIRCRAFT ENGINEERS in a variety of fields.

If you desire to join the Rohr engineering team, here in the sunny, smog-free area of Southern California, you are invited to investigate.

Please forward resume of education and experience to J. H. Hobel, Industrial Relations Manager, Rohr Aircraft Corporation, Chula Vista, California, Dept. No. 4.

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"Research for Space"

1958's big AVIATION WEEK editorial theme

June 16th marks the publication date of AVIATION WEEK's "Research for Space", 1958's most ambitious and dramatic editorial effort. Major areas of editorial attention: missiles, satellites, spacecraft, space probes, Dyna-Soar, avionics, exotic fuels and hypersonic aircraft, are presently engaging the attention of the world and exciting the imagination of scientific and military minds everywhere. The soaring national defense expenditures earmarked for national defense effort in these fields and general aviation procurement, amounting to some $10 billion scheduled to be expended in the second half of 1958, i. e. (January-June 1958) spotlight the timeliness of this issue.

Last year's "Research and Development" issue generated over 18,000 top-quality inquiries. This year's "Research for Space" edition will exceed this number substantially. *Regular AVIATION WEEK* contract rates will apply. Positions will be accorded on the basis of the date insertion orders are received. Now is the time to schedule your advertising message in 1958's most dramatic and useful edition, "Research for Space".

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Graduate Chemist. Thirteen years experience conducting, planning, and directing development and applied research on aircraft and automotive petroleum and synthetic oils, hydraulic fluids, gasoline, jet fuel, and on physical and chemical evaluation techniques. Age 34. Married. Two children. Prefer West Coast location. PW-7916, Aviation Week.

POSITIONS WANTED

ATR Pilot, Lodestar, DC-3, Twin-Beech, 6000 hrs sched. air-carrier, USAF, and recently Executive. No accidents. No Violations, College Educ. in Engrg; Mechanical exper. Excel. References. 37. Family. Resume on request. PW-7972, Aviation Week.

ATR Pilot. 4000 hours. No accidents. Exp. in light twins. Age 29. Married. Will relocate. PW-8063, Aviation Week.

Comm Inst. Pilot with A&E ratings, 3000 hrs W. Coast flying. Age 40. Desires fly & maintain light twin for L. A. Co. Also Sales Background. PW-8031, Aviation Week.

Corporation flying position and/or South American assignment desired. Airline transport pilot, DC-3, DC-4, C-46, light twins, 6700 hours. Aggressive, age 30. Writes, Reads, Translates Spanish fluently. PW-8028, Aviation Week.

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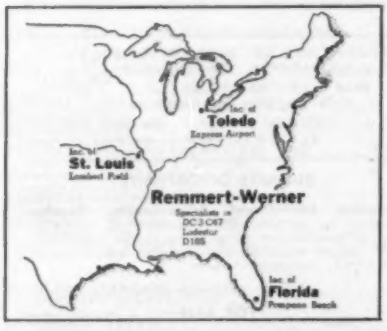

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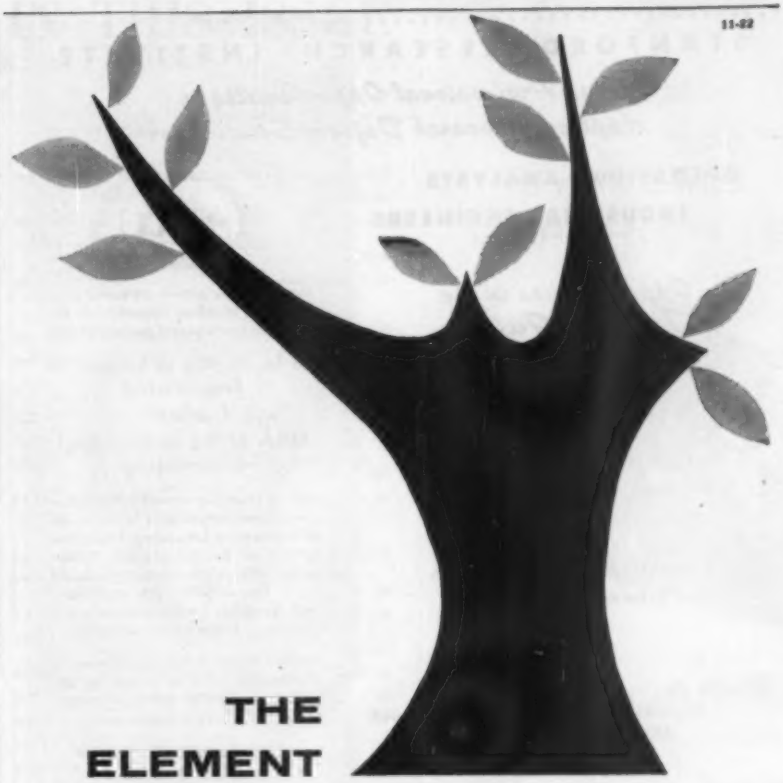

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Airplanes for Sale

Mixed up world!

When an airline has to sell its airplanes to stay solvent because the pilots are on strike and at the same time airfreight lines are selling airplanes because of no business, then I believe some pilots would be glad to swap jobs. Warning to the greedy. Someone will invent a pushbutton and you will lose everything.

FRANK FRUGOLI
High Springs, Fla.

Radome Maker

Page 76 of the April 14 issue of AVIATION WEEK covers production of the Grumman WF-2 airplane with early warning radar.

Your statement therein regarding manufacture of the large radome, a critical part of the system, is seriously in error. While Hazeltine engineers have developed the electronics within the radome and have maintained close liaison on its development, the tremendous task of designing, tooling, building and testing the part was (and still is) entrusted to Zenith Plastics Co.

We would appreciate your setting the records straight. Never can tell when someone will want a bigger one, and we're the people who can do it.

S. S. OLEESKY
Chief Scientist
Zenith Plastics Co.
Gardena, Calif.

Lighted Aircraft

Reference to the subject of mid-air collisions, it appears that much is being said and little, as usual, is being done to eliminate the problem.

I would like, if it seems worthwhile, for AVIATION WEEK to pick up the banner on a lighting system I have proposed to the Military Air Transport Service as a possible solution to night operations.

Every person connected with aviation is aware of the limitations of the present system which utilizes position lights of either steady or blinking variety wth the rotating Grimes light. These give what is essentially a point presentation and do little to define location (ground or air), direction of travel or object size. It appears to me that an alternate approach towards an object presentation is very feasible.

Keeping in mind the size of the form holding these lights aloft and the remembrance of aircraft caught in a searchlight at night, it seems that a good solution would be to use this size and reflective quality by illuminating the outside of the aircraft with white lights. Wing mounted lights illuminating the fuselage, forward lights mounted under the cockpit shining on the propellers and fuselage lights directed on the wings should provide adequate definition and direction of travel. Similarly, this should effect better than daylight warning capability by the simple expedient of effective contrast—the most important force in gaining attention.

There are, of course, deterrent factors such as passenger reaction (which is, or should be, secondary to the primary safety considerations), and the problem of glare to the pilots. These are not, however, irresolvable since flight tests should prove that proper placement and defined usage could keep irritation to a minimum. In any event, the important objective of adequate warning cannot be compromised.

This is forwarded in the hope that it may provide a partial solution to the problem. I feel sure that had either aircraft been so illuminated we would not have lost the MATS C-118 or the Navy Neptune over Long Beach in February.

MAJ. JOHN J. McELROY
1611th Operations Sqdn.
McGuire AFB, N. J.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Cockpit Confusion

The CAB report, concluded on p. 101 of your Feb. 3 issue, thoroughly explains but neither condemns nor condones the system of altimeter settings that was in use when an airliner crashed during a weather approach.

Notwithstanding your label of the report "Lack of Alertness Cited in Airline Crash" and the CAB's findings, my wholehearted sympathies are with the flight crew. The crew got tripped using a system that requires the management of two separate altimeter settings and two pilots in one cockpit. Under the system one altimeter is set to indicate height above sea level, another altimeter is set to indicate height above the field only. There may even be a third altimeter set to sea level.

In my opinion, the system sets up a built-in opportunity for confusion in the cockpit. This fault more than outweighs its merits. I am biased to the other system that requires all altimeters be set to read above sea level. Pilots must then think in terms of all heights being as above sea level. That includes field, aircraft, and surrounding obstacles. Pilots then have one less thing to worry about, namely another altimeter setting and its peculiar relation to terrain, which may be none at all, and other altimeters.

My concern about this was such that I phoned the CAB mainly to find out which lines used the system and why no biased remarks had been made about the system in the accident report. I learned that several airlines, in their search for safety, go well beyond what the regulations require on altimeters. They spend much money on extra altimeters and for indoctrination of crews in their use as applies to the multi-setting system.

Nevertheless, I have come to believe that there can be such a thing as too many well intentioned gadgets and gimmicks that actually serve to defeat the purpose of safety by providing pilots with another opportunity to commit a very human error.

After writing the foregoing, I had vague memory of such an accident having possibly happened before. To check, I visited the CAB records archives. You may be interested in the following facts, opinions and conclusions.

An airline crash near Atlanta about 17 years ago, on Feb. 26, 1941, has certain things in common with the one near Tulsa in January, 1957.

Both accidents occurred during instrument weather approaches. The respective aircraft hit terrain several miles short of the airports. In both cases the CAB reports discuss altimeter settings as a pertinent factor.

In the earlier accident the captain's "field pressure" altimeter was thought to have been set incorrectly. In the investigation of the 1957 accident it was verified by testimony that the "field pressure" altimeter had been cross checked with the "sea level" pressure altimeter for the correct relationship.

However, this cross-checking did not prevent the 1957 accident, although it was hypothetical in 1941 that such cross-checking would have prevented the 1941 accident.

In each case the CAB reports mention or discuss, in a noncommittal manner, the system of diverse altimeter settings, yet in each report the captain pilots are attributed with having erred by either not having been alert or by not having exercised due care and much of it about altimeters.

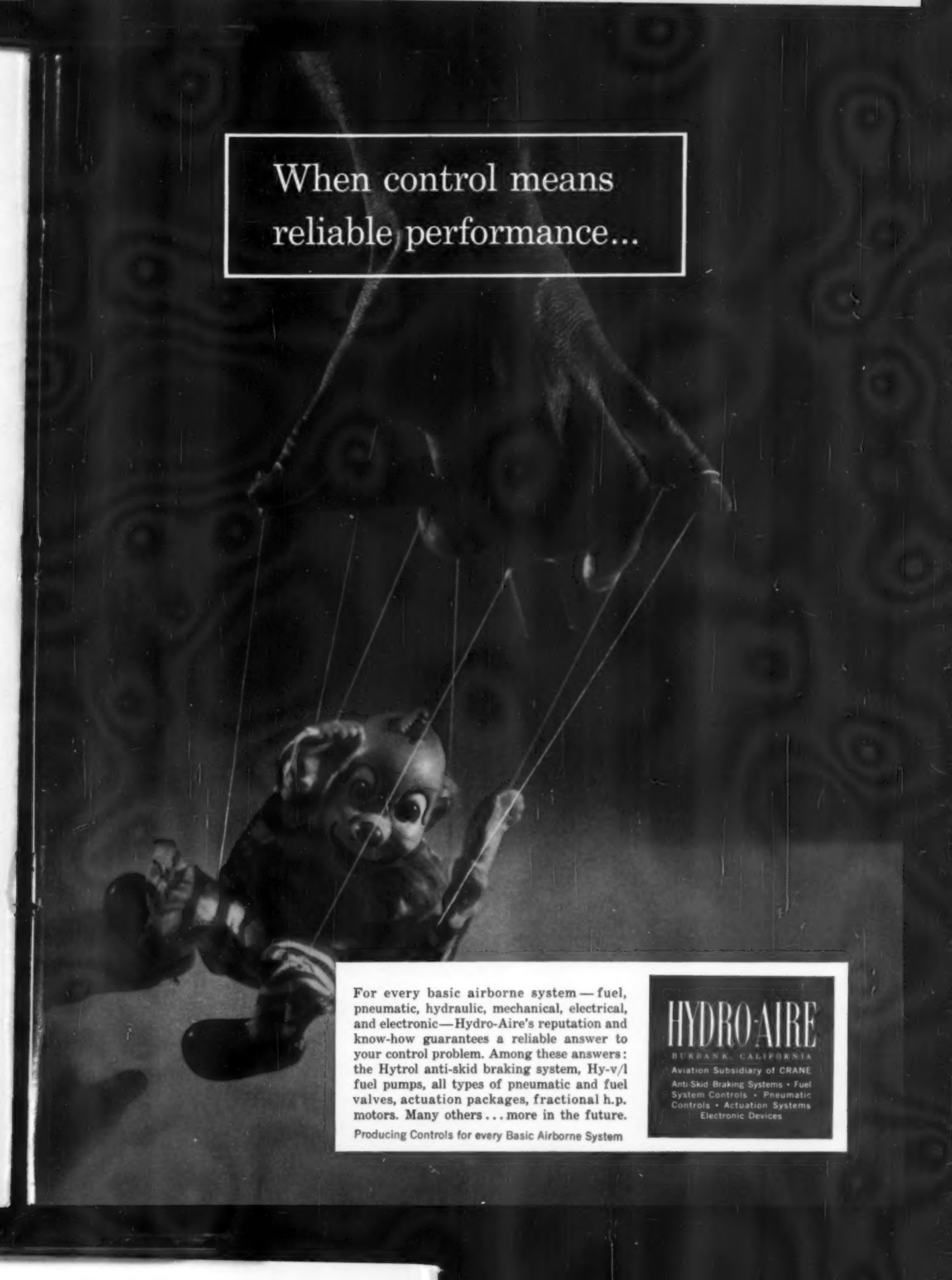
When one studies these two CAB reports, issued over 16 years apart, I believe one cannot escape a startling conclusion—neither accident would have happened if the system of diverse altimeter settings had not been in use.

Take the 1941 accident. Had all cockpit altimeters been set to a uniform sea level reading, even to the setting on the "sea level" altimeter that was retrieved from the wreck, the final instrument approach could have been executed without accident. The captain of that 1941 trip wouldn't have been involved in an erroneous setting on a "field pressure" altimeter.

Take the 1957 accident. Had the altimeter system been employed where all cockpit altimeters are set to a uniform sea level reading there would have been no opportunity for a misunderstanding about altimeters which the CAB report indicates to have existed between the captain and copilot.

One airline accident does not spell a trend, but two of similar connotation (though 16 years apart) are company. Three could be a crowd in airline accident history. That is why I believe that the matter of altimeter system should be subjected to the scrutiny of informed aviation opinion such as can be found among your readers. This seems much more important to me than such matters as whether cocktails are served or whether flights arrive on time, both of which have been given full treatment in your columns.

ROBERT E. TRIMBLE
Washington, D. C.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